Establishing Alaska Subsistence Exposure Scenarios
ASPS #97-0165

Submitted to the Alaska Department of Environmental Conservation

September 1, 1997

IDM Consulting
1222 25th Ave. E.
Seattle, WA 98112

Executive Summary

IDM Consulting was contracted by the Alaska Department of Environmental Conservation to evaluate existing subsistence information in an effort to define subsistence regions and develop subsistence consumption parameter distributions for use in human health risk assessment. The project was divided into three parts: 1) Determining appropriate Alaska resource needs areas for the study; 2) Conducting sensitivity analysis on subsistence risk calculations to determine which variables contribute most to the overall risk assessment; and 3) Conducting subsistence research and preparing point estimates and probability density functions for all input parameters for the variables identified in Task 2 for each resource area identified in Task 1. Contained herein are the methods, results and discussion for each component task in this project.

The September 1996 Community Profile Database harvest data from the Alaska Department of Fish and Game (ADFG), Division of Subsistence, was used to examine the utility of alternative subsistence regional classifications in examining regional harvest practices. ADFG harvest information, including annual village population and resource harvest for 202 villages from 1980 to 1995, were used to examine intra- and inter-regional variability in subsistence harvest. Although harvest trend analysis was originally a goal of Task 1, the lack of village re-sampling information has made an evaluation of year-to-year fluctuations in harvest within villages impossible.

The Community Profile Database contains harvest information on all significant harvest resources. Major harvest categories include salmon and non-salmon fish, large land mammals, small land mammals, feral animals, marine mammals, migratory birds, non-migratory birds, bird eggs, marine invertebrates, and vegetation (i.e., plants and berries). In the analyses presented here, three subsistence region classifications available on the Community Profile Database were evaluated: ADFG subsistence region boundaries (n=6); Federal subsistence region boundaries (n=10); and Ecological-Cultural region boundaries (n=5).

To determine the most appropriate regional scheme for use in establishing subsistence consumption risk parameters, per capita harvest information was analyzed using both parametric and non-parametric methods for each of the three subsistence region classifications. An evaluation of the per capita harvest rate distributions supports the use of non-parametric analyses in defining the selection of the most appropriate regional classification. By ranking each of the five most significant resource harvest categories according to region, it was possible to identify the Ecological-Cultural regional scheme as the most appropriate choice for developing the subsistence consumption parameters for use in Task 2.

To further evaluate subsistence dietary patterns in Alaska, IDM compared the Alaska Department of Fish and Game Community Profile Database (CPDB) harvest survey results and Indian Health Service consumption survey results, where data existed in both databases. Because the CPDB harvest data are available for many more communities than the consumption data, it was preferable to use the harvest data in developing probability distributions to represent dietary subsistence intake. However, it has not been generally established that harvest data provide a good representation of subsistence consumption patterns in Alaska. IDM evaluated both the harvest data and limited consumption data in order to better understand the relationship of these two data sources. Our analysis of 7 Alaska communities for which both harvest and consumption data were available indicates that harvest and consumption are well correlated, although harvest data significantly overestimates consumption for some resources. In the

absence of more extensive consumption data, however, harvest data may be reasonably used as a surrogate for preliminary estimation of consumption. While it is not appropriate to make inferences regarding regional consumption directly from the limited consumption data that are available, some interesting features are noted.

In order to specify probability distributions representing dietary resource use, IDM first calculated community per capita (mean) harvest rates for 11 major resource groups in each of the Ecological-Cultural regions defined in the CPDB as outlined in Task 1 of this project. These values were then fit to 11 common continuous probability distribution functions (PDFs) using maximum likelihood estimation of parameters. For each resource consumed in each region, parameters for two distributions are reported: the lognormal PDF and the best-fitting PDF as determined by the Kolmogorov-Smirnov goodness-of-fit test. Either of these distributions may be used to represent the variability in community per capita resource harvests within the corresponding Alaska Ecological-Cultural region.

Identifying the most significant resources to the risk assessment process requires quantification of both resource use and of potential resource contaminant concentrations. When both of these can be effectively modeled, the most influential components in the exposure assessment portion of the process may be identified. The significance of resources in influencing risk estimates also depends on the toxicity of the contaminants under consideration. Because contaminants vary from site to site, and no site-specific evaluations were requested for this project, IDM selected broad classes of chemicals of interest to demonstrate the potential impact of resource consumption on contaminant exposure, given typical contaminant levels observed in subsistence foods across the U.S. Although the exposure estimates used in our analyses do not necessarily pertain to Alaskan communities, they are useful for outlining a methodology for analyzing the significance of subsistence resources to estimate chemical exposure, and for examining the general importance of specific subsistence resources in contributing to exposure to several classes of hazardous chemicals.

In order to assess the impact of contaminants on human health three types of information are needed: the amount of intake of foods that may contain contaminants, the concentration of the contaminant in a food, and the toxicity of a given level of a contaminant. Information at all three levels is limited, especially information specific to Alaska. This project addresses the first type of information, potential exposure, by examining intakes of major subsistence resources in different Ecological-Cultural regions. Although potential contaminants of concern are proposed as part of the analyses presented here, there is no attempt to calculate risk to communities or individuals, or in any way describe the effects of contaminants. Rather, this project was undertaken as a first step in estimating regional dietary intake rates of subsistence foods in Alaska.

The findings of this study can serve as an initial screening tool for identifying food resources consumed in greater quantities in a region, for the identification of data needs when performing site-specific risk assessments, and for preliminary risk estimation for communities when contaminant information is available. However, there are some limitations in applying the findings. Because of the limited availability of data related to subsistence dietary patterns, the possibility of considerable differences between estimated intakes and true intakes must be considered. Additionally, because the available data were collected for too few days per season per person to adequately quantify annual subsistence harvest or consumption at the individual level, the probability distributions recommended here only represent variation among community per capita (mean) harvest rates. While individuals with high harvest rates are recognized and included in the calculation of per capita harvest, the distributions recommended do not specifically address their behavior. Moreover, the analyses presented here evaluate consumption and harvest at the level of the species, neither tissue- or organ-specific consumption are considered, nor are food storage and preparation practices considered in these analyses. Because of chemical partitioning among different tissues, the use of a resource-level exposure analyses may significantly bias exposure estimates. With these limitations in mind, examination of the assumptions made in the models presented here and a more thorough assessment of consumption as a source of exposure at specific sites is strongly recommended.

Table of Contents

List of Appendices

List of Tables

List of Figures

1.0 Introduction

IDM Consulting was contracted to evaluate existing information on Alaska subsistence practices by the Alaska Department of Environmental Conservation. This effort was undertaken to define subsistence regions and develop subsistence consumption parameter distributions for use in human health risk assessment. The project was divided into three tasks: 1) Determining appropriate Alaska resource needs areas for the study; 2) Conducting sensitivity analysis on subsistence risk calculations to determine which variables contribute most to the overall risk assessment; and 3) Conducting subsistence research and preparing point estimates and probability density functions for all input parameters for the variables identified in Task 2 for each resource area identified in Task 1. Contained herein are the methods, results and discussion for each component task in this project, and combines information provided to ADEC in a Task 1 Draft Report submitted July 7, 1997, and the Task 2 Draft Report submitted August 4, 1997.

To perform these analyses, IDM Consulting used harvest data found in the Community Profile Database of the Division of Subsistence, Alaska Department of Fish & Game (ADFG, 1996). The Community Profile Database is a central repository of information on contemporary subsistence uses within Alaskan communities. It was developed by the Division of Subsistence, Alaska Department of Fish and Game (ADFG). Mandated by Alaska state law in 1978, the Database is designed to serve as a principal reference source for recent, reliable summary information about the subsistence uses within the economies of rural Alaskan communities. IDM Consulting used the electronic version of the Database (September 1996), designed for use with Microsoft Access software to conduct the information retrieval and analyses presented herein. The September 1996 version of the Community Profile Database includes information on 202 communities from 85 projects conducted between 1980-1995 by researchers in the Division of Subsistence. Besides ADFG survey information, information used in the Community Profile Database was provided by the US Fish and Wildlife Service, Stephen R. Braund and Associates, Kawerak, Inc., the US Census Bureau, and the Alaska Department of Labor.

ADFG typically gathers subsistence harvest information for inclusion in the Community Profile Database through detailed retrospective interviews with harvesters from a sample of households within each of the surveyed communities. Respondents are asked questions about their household's use of wild resources. They are typically asked to estimate the quantities of particular species harvested and used during the previous 12-month period, including the sharing of wild resources between households.

Because it is a comprehensive source of harvest resource use in Alaska, because the harvest information was collected using consistent methods, and because it allowed for further analyses, IDM Consulting selected the Community Profile Database to evaluate the selection of alternative subsistence regions in developing default, region-specific subsistence consumption parameters. While there are some strong advantages to the use of the Community Profile Database in defining subsistence regions for use in human health risk assessment, there are some limitations. For example, although the CPDB includes most of the rural communities in Alaska, it excludes residents of urban centers, such as Anchorage, Fairbanks and Juneau. While the CPDB describes amounts of resources harvested, it does not report amounts *consumed* nor does it describe *which parts* of the animal are consumed. These data are important for quantifying exposures to and risks from some chemical contaminants. The results of the harvest data analyses form the basis for the Task 1 report provided below.

As a result of the Task 1 analyses, the Ecological-Cultural region definition defined in the CPDB was shown to provide the highest degree of discrimination in harvest practices among regions in Alaska, supporting its use as the default regional definition for use by ADEC when examining subsistence issues. Using that evaluation as a basis, IDM Consulting has defined harvest probability distributions for each major resource category and Ecological-Cultural region, the results of which are presented here as the Task 2 and Task 3 reports. To examine the sensitivity of risk models to the defined resource harvest distributions, an evaluation of contaminants reported in the various resources was undertaken using broad contaminant distributions. While the contaminant levels are not specific to Alaska but are based on nationally-reported values, they are included to demonstrate the use of the harvest distributions in exposure screening analyses, and to provide insight into resources of interest for various chemical classes.

In addition to defining the harvest probability distributions by region and harvest resource, IDM Consulting has compared the CPDB-derived community resource harvest against surveyed consumption rates in an effort to explore the use of these two data sets in examining subsistence practices. While the community harvest data was obtained using the CPDB, community consumption information was obtained through the Indian Health Service in collaboration with five Alaska Native Health Corporations. Use of consumption information in this project was graciously approved by the Alaska Native Health Board. We present seasonal trends in resource consumption and a comparison of annual harvest and annual consumption rates. Correlation and slope comparisons of harvest rates and consumption rates are provided both by resource (across all communities) and by community (across all resources).

2.0 Methods

2.1 Task 1 Methods

Alaska covers an area of 586,000 square miles, which equals almost one-fifth of the area of the continental United States. Within the state's borders there are different ecological, cultural, and climactic regions. Different agencies have defined subsistence regions within the state for different purposes, and with varying degrees of precision. Seven different regional classification schemes are available for use in the ADFG Community Profile Database. In this section, we describe the process used to evaluate the most appropriate regional classification scheme among three of the available schemes: the ADFG subsistence regions (n=6), the Federal subsistence regions (n=10) and the Ecological-Cultural subsistence regions (n=5). A rationale for the selection of these regional schemes for further analysis is provided under *3.1 Task 1 Results*.

To identify which of the three regional classification schemes best differentiated subsistence resource harvest behaviors among its regions, and was therefore the most appropriate selection for use by ADEC in defining region-specific default subsistence parameters, both parametric and non-parametric statistical analyses were conducted using the top five subsistence harvest resource categories. While 6 other major resource categories were available for the evaluation, they represented at most only about 11% of any region's harvest. These minor harvest resources were not used in the final ranking of regional classification schemes because it would not be appropriate to base the choice of a regional classification scheme on resources with such small harvest rates.

The process of selecting the most appropriate regional classification scheme involved the following steps:

1. Calculating an appropriate measure of harvest for each region within each subsistence region classification scheme.
2. Using analysis of variance (ANOVA) to determine if the harvest patterns among the regions of a classification scheme were statistically equal.
3. For those resources which ANOVA determined did not have equal regional harvest patterns, using pairwise comparisons of the regions to determine which regions were statistically different.
4. Recording the number of differences found per number of comparisons made and ranking the classification schemes based on the percentage of differences found.
5. Confirming the results by exploring other analytical approaches.

IDM has used Microsoft Access (v. 7.0 for Windows) to develop appropriate queries of the Community Profile Database. Statistical analyses have been conducted using Microsoft Excel (v. 7.0 for Windows) and SPSS (v. 4.0 for Macintosh and v. 7.5 for Windows).

2.1.1 Calculating an Appropriate Harvest Measure for Each Region

To help identify which resources are most harvested in the State of Alaska, IDM ranked the resources based on total pounds harvested. Total pounds harvested was calculated for each resource as the sum across all communities of the values in the database field *xtotlbs* (in the field dat:harvest). Some communities were surveyed more than once, and they had multiple *xtotlbs* values for the same resource. In these cases, the multiple entries were averaged, and the average was used.

Community per capita harvest data are included in the Community Profile Database, recorded in the field *percap* in table dat:harvest. As is the case with the field *xtotlbs*, some communities have multiple *percap* values for the same resource because more than one annual survey exists. Therefore, to ensure that each community had only one number representing per capita values for the harvest of each resource, a community's per capita harvest rates were calculated based on averages of total pounds harvested, and averages of estimates of the population size of the community for the different years the community was surveyed.

Regional per capita harvest rates were based on the community values for total pounds harvested and estimates of community population size. (Values for communities surveyed more than once were averaged before regional per capita harvest rates were calculated.) Regional per capita rates were not calculated as the simple average of the community per capita rates (i.e. they were not based on the *percap* field in the Table dat:harvest). The equation took the following form:

$$\textit{regional per capita harvest per resource} = \frac{\sum \textit{total lbs harvested per resource}}{\sum \textit{community population sizes}}$$

When reported, values of "zero" per capita harvest were included in the analyses, while data blanks were not evaluated as "zeros", but were excluded from analyses.

2.1.2 Analysis of Variance

Analysis of Variance - Parametric Analysis: To account for the harvesting behavior of smaller communities, IDM equally weighted all communities for ANOVA and the pairwise comparisons. Means and variances were calculated for parametric analysis as part of the ANOVA process. Preliminary analysis and the high variability in the data indicated that parametric analysis should be conducted on log-transformed data.

For parametric analysis, one-way ANOVA was used to determine if all regional per capita rates were equal at an α=.05. If the ANOVA analysis indicated that the regional per capita harvest rates were not all equal, pairwise comparisons were justified. Regions with less than three communities harvesting a resource were excluded from parametric analysis.

Analysis of Variance - Non-Parametric Analysis: Non-parametric analyses were used to evaluate how the choice of regional classification affected the discrimination of resource harvest patterns between regions without having to assume any distributional form to the harvest data. This approach was applied because of the potential for non-normally distributed data among community per capita harvest rates. Because this statistical method does not make assumptions regarding the distribution of the data, no data transformation was required prior to the non-parametric analyses.

Kruskal-Wallis One-Way ANOVA was conducted to determine whether there were any statistically significant differences in per capita harvest among any two regions within each of the three regional classification schemes. This non-parametric test ranks the per capita harvests of the resources of interest for each pair of regions within a regional classification, evaluates each region's summary rank score, and determines whether the per capita harvests (based on regional rankings) are more likely to represent two regions or one (α = 0.05). The output of this analysis is a summary value that can be used to determine whether the per capita harvest rates can be considered equal. As with the parametric ANOVA, while the test can provide information that there are differences between regions in their harvest rates, there is no indication as to which or how many of the possible regional pairs are different.

2.1.3 Pairwise Comparisons

ANOVA results may indicate that statistical differences exist between regional per capita harvest rates, but they cannot tell where the differences exist (i.e., between which regions for a particular harvest resource). For this reason, IDM used pairwise comparisons to determine how many regional differences could be identified within each regional classification and where those differences occur in per capita harvest rates. When performing multiple pairwise comparisons, it is important to consider the use of multiple comparison correction methods. IDM has explored the application of various multiple comparison methods including Scheffe (for the parametric analyses) and Bonferroni (for both the parametric and non-parametric analyses). Because Bonferroni correction is the most conservative multiple correction method, we applied Bonferroni correction to determine whether adjusting for multiple correction would alter the ranking outcomes. Details are discussed below.

For parametric analysis, the two-sample two-tail t-test was used at $\alpha=.05$ on the community per capita harvest rates. For non-parametric analysis, the Mann-Whitney U pairwise test was used at $\alpha= .05$ on the ranks of the community per capita rates. This rank-based test is similar to the Kruskal-Wallis test: regional per capita harvest information from two regions of a particular resource are ranked, the ranks are summed according to their regional category, and the ranks are compared to examine whether they are more likely to represent two groups rather than one.

2.1.4 Ranking the Classification Schemes

For each regional classification scheme, the number of statistically different comparisons ($p<.05$) between regions were noted as a percentage of the total number of comparisons made for each resource. In this way, the total number of comparisons made was normalized across regional classification schemes. This approach was selected to prevent the relatively large number of comparisons in the Federal subsistence region classification from biasing the outcome of the analysis. The regional classification schemes were ranked for each resource based on the percentage of significant differences found.

2.1.5 Evaluating the Regional Ranks

IDM confirmed the results of the regional ranking process by evaluating the ramifications of two types of changes in the analysis.

1. Performing multiple pairwise comparisons results in increasing chances for Type I errors (false positives), and the results cannot be confirmed at the desired α level. Therefore, IDM evaluated all t-test and Mann-Whitney results using the Bonferroni correction method to determine if correcting for the increasing likelihood of Type I errors would change the conclusions of the analysis. The Bonferroni method multiplies the p value by the number of comparisons made to account for the increased likelihood of false positives. It was selected because it is the most conservative correction method available. Applying it changes the number of significant differences found both parametrically and non-parametrically. However, its application does not change the conclusions as to which regional scheme is best.
2. IDM selected one method for ranking the three different regional schemes, but other methods exist for comparing the number of differences found. IDM looked at the percentage of differences calculated across all comparisons (not just within resource); the average of the

percentage of differences for the resources; and the number of times a regional scheme was ranked first. IDM also evaluated the three regional schemes non-parametrically for all eleven resources even though resources harvested at low levels should probably not be used to define regional differences.

2.2 Task 2 and Task 3 Methods

Two major sources of data were identified and utilized for the evaluation of subsistence dietary patterns in Alaska Natives: ADFG harvest survey results and Indian Health Service consumption survey results. While the harvest data are available for many more communities than the consumption data, it has not been previously established whether they provide a good representation of subsistence consumption patterns. In order to better understand the relationship of these two data sources, IDM Consulting evaluated both sets of data and conducted comparisons where appropriate.

Identifying which resources are most significant in risk assessment requires quantification of resource use (i.e., species, tissues and quantities consumed) and of contaminant concentrations. When such information is available for analysis, the most influential components influencing chemical exposure may be identified. The contribution of resource consumption to individual or population risk will also depend on the toxicity, or chemical potency, of the contaminants under consideration. Because contaminants vary from site to site, and no site-specific evaluations were requested for this project, IDM selected broad classes of chemicals of interest to use in evaluating the impact of various resources on exposures, given typical contaminant levels observed in consumed species across the U.S. Although the exposure estimates were derived from broadly selected contamination levels representative of potential contaminant loads in various species across the U.S., and are thus not appropriate for estimating contaminant exposures in Alaska, these estimates are useful for examining the general importance of specific subsistence resources in determining exposure to several classes of hazardous chemicals.

2.2.1 Obtaining subsistence consumption data

To describe intake of indigenous foods for this investigation, 24 hour dietary recall data from eleven communities within five Alaska Native Health Corporations that were obtained as part of a separate study (Nobmann et al., 1992) were analyzed using Microsoft Access 97. When necessary, questions about computerized values were verified against the raw data. The use of the community consumption data for this investigation was graciously approved by the Alaska Area Indian Health Service Institutional Review Board and the Alaska Native Health Board. The Alaska Native Health Board has representatives from the five Alaska Native Health Corporations that collaborated in the initial investigation. Seven of the eleven communities are located in ecological-cultural zone 1, one in zone 3, two in zone 4, and one in zone 5. Of the eleven communities where consumption data were available, only seven had comparable harvest data available on the CPDB.

2.2.2 Comparing harvest data with subsistence consumption data

In order to compare consumption rates with harvest rates it was necessary to convert the consumption data to match the harvest data, which was defined in the CPDB as the wet weight of a food as it might enter the kitchen. The consumption data were converted to wet weight by multiplying the grams of food consumed by a conversion factor (the multiplicand used to convert cooked food to raw food) derived in one of several ways. Whenever appropriate yield ratios (cooked food yielded from raw food) were published, they were used to establish the conversion factor (USDA, Poultry Products, 1979; Finfish and Shellfish Products, 1987; Game Products, 1989). Yield ratios were not always available, especially for dried foods and sea mammals. In those cases, a ratio of water in the raw food (or a similar food) to water in the product-as-consumed was used (Nobmann, 1993); this method may not account for all losses during cooking but it accounts for most of the differences in weight. Unique conversion factors were needed for still other combinations of foods, such as Agutuk or Eskimo ice cream, which is frequently made from shortening, berries and sugar. For mixed foods a standard recipe as reported by a participant was used to define the conversion factor. To allow comparison with the harvest rates, consumed foods were placed in resource groups based on the predominant food ingredient. If a food such as King salmon roe was eaten either cooked or raw, the conversion factor for the predominant preparation method was used as determined by reviewing the raw data. Lacking any more specific conversion factor for sea mammal oils and blubber, a conversion factor of one was used. There were 138 local foods reported as eaten for which conversion factors were generated (Appendix J).

In the absence of nutrient data on local greens, which would allow a more refined classification, local greens were coded as spinach. This approach could result in over-estimation of consumption of local greens because spinach purchased from the store was not considered separately. We chose to overestimate rather than underestimate potential consumption of local greens by including all food coded as spinach. Similarly, it is impossible to tell from the records if some products are commercially processed or made from local ingredients, i.e. canned salmon, blueberries, strawberries, raspberries, mushrooms, and canned clams. We chose not to adjust these estimates, which may overestimate dietary consumption of local resources.

Wet weights of each food consumed by an individual were aggregated by day, and individual intakes were aggregated by community and resource category. Resource categories were defined using criteria established in the CPDB. Twelve resource categories were described: salmon, non-salmon, large land mammals, small land mammals, feral animals, marine mammals, migratory birds, other birds, bird eggs, marine invertebrates, vegetation (including berries) and berries considered separately.

To obtain the per capita consumption of the resource by community and season, the integrated resource consumption, as wet weight, was divided by the number of people interviewed in that season and community. Because data were gathered during two summer seasons, resource consumption rates from the two summer surveys were combined and divided by the total number of person-days in both summers. Annualized intake estimates were obtained by multiplying the per capita consumption in each season by 91.25 (representing ¼ of the year) and adding the seasonal consumption rates. Values were converted to pounds to compare with the CPDB harvest rates for each resource and community. Data are reported as mean $\pm$ standard error of the mean.

Comparisons between reported annual harvest and consumption rates were possible for seven of eleven communities where consumption data were gathered. Pearson correlation values were calculated to examine correlation between harvest and consumption rates by resource (across all communities) and by community (across all resources). Such an analysis allows for an evaluation of whether there may be site- or resource-specific influences that contribute to variability in how well the two data sets correlate with one another. In addition to examining correlations, we report results from analyses of the regression of harvest rate by consumption rate by resource (across all communities) and community (by all resources). Such an analysis can be used to examine the nature of the relationship between harvest and consumption, and specifically how much of the reported variability in harvest rates can be explained by consumption practices. While potentially useful as a guide to understanding the relationship between harvest and consumption, the assumptions made in deriving the rates used in these analyses make the interpretation of the data difficult, at best.

2.2.3 Quantifying resource use

Food resources were ranked for each community using the per capita consumption of each resource. Because consumption survey data were available for only eleven communities, IDM sought to quantify the uncertainty in resource consumption with appropriate probability density functions based on resource harvest rates. To this end, the community per capita harvest rates for each resource within each of the five Ecological-Cultural regions were fit with maximum likelihood estimation techniques to the following 11 continuous probability density distributions available in the Crystal Ball software package: uniform, normal, triangular, log-normal, exponential, Weibull, beta, gamma, logistic, Pareto, and extreme value. The Kolmogorov-Smirnov goodness-of-fit test was applied to all distributions for each region and resource, and the distribution with the lowest test statistic was selected as the "best fit." The parameters of the best-fit distribution were recorded for each resource regardless of whether the fit was considered to be very close as determined by the Kolmogorov-Smirnov test. In some cases, best-fit distributions ranged to values below zero. To preclude the possibility of selecting negative harvest rates, these distributions were truncated at zero on the lower tail.

Because the differences between test statistics for competing distributional shapes can be very slight, some risk assessors advocate the use of a preselected distributional shape for PDF fitting (Lee and Wright, 1994; Taylor, 1993). The distributional shape can be selected based on a number of factors other than goodness-of-fit measures, including known limitations on the range of the data, knowledge of the processes responsible for variation in the data, and convenience of use. With these considerations, the log-normal distribution may be an appropriate choice for a preselected distribution to represent intercommunity variation in harvest or dietary consumption rates. The log-normal distribution is commonly used to represent variation in measured environmental contaminant concentrations and exposures and has previously been applied to assess dietary contaminant exposures in Arctic subsistence communities (Chan *et al.*, 1997).

In addition to the statistically-defined best fit distribution, community per capita harvest data were also fit to log-normal distributions; these log-normal distributions were then compared to the best-fit distributions. Kolmogorov-Smirnov test values, 50^{th}, 90^{th}, and 95^{th} percentiles of harvest, and resulting estimates of dietary contaminant exposures were calculated for both distributions for each region and resource.

2.2.4 Determining hazardous substances most likely to bioaccumulate

Many different hazardous substances have been identified as contaminants at hazardous waste sites. In order to conduct a preliminary investigation of the potential for these substances to bioaccumulate, IDM focused on the top 20 hazardous substances on the priority list developed by the Agency for Toxic Substances and Disease Registry (ATSDR) and the Environmental Protection Agency (EPA). The priority list is an annually revised list of 275 hazardous substances ranked by potential threat to human health. Under section 104(i)(2) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), three criteria are used to determine potential health risks for this priority list: 1) frequency of occurrence at NPL sites, 2) toxicity, and 3) potential for human exposure. The list is available on the Internet through the ATSDR home page (http://atsdr1.atsdr.cdc.gov:8080/cxcx3.html). The top 20 substance on the priority list appear as follows:

1. lead	6. PCBs	11. DDT, P'P'-	16. chlordane
2. arsenic	7. cadmium	12. Aroclor 1260	17.dibenz[a,h]anthracene
3. metallic mercury	8. benzo(a)pyrene	13. trichloroethylene	18. hexachlorobutadiene
4. vinyl chloride	9. chloroform	14. Aroclor 1254	19. DDD, P'P'-
5. benzene	10. benzo(b) fluoranthene	15. chromium (+6)	20. dieldrin.

These 20 substances may be grouped into the following five categories:

- metals;
- organochlorine pesticides;
- PCBs (polychlorinated biphenyls);
- PAHs (polycyclic aromatic hydrocarbons); and
- VOCs (volatile organic compounds).

Of these categories, all except VOCs have been identified as bioaccumulating in some organisms. IDM compiled information on the concentrations in the types of resources consumed by subsistence users for contaminants in the four categories known to bioaccumulate. Data on contaminants listed above were available in the ATSDR toxicological profiles and other published literature for many of the types of resources included in the ADFG database. While contaminant distributions are proposed herein, these distributions should not be used to evaluate risks to Alaskan residents as they do not necessarily reflect contaminant levels in resources consumed by Alaskans. Moreover, these analyses do not attempt to evaluate species-specific or tissue-specific factors that will strongly influence chemical concentration in consumed foods. Rather, the distributions examined here are used to examine the sensitivity of the risk models to the selection of regional harvest rate distributions by species.

2.2.5 Quantifying potential resource contamination

To quantify the potential contamination in the different resources, IDM referred to the information collected on the categories metals, organochlorine pesticides, PAHs, and PCBs. Reported mean concentrations in a resource were used to represent potential contamination levels. When the toxicological profiles or other sources of information provided ranges of contamination for a resource, IDM assigned uniform distributions to the data to represent the ranges of potential contamination levels. If averages were provided along with the ranges, IDM assigned triangular distributions to estimate the contamination levels. Triangular distributions were based on the minimum and maximum of the specified range, and the average was used as the most likely value. Triangular distributions were used in these cases because variances or standard deviations for the data were unavailable.

Table 1 presents a summary of the resource contamination information derived from the ATSDR toxicological profiles; the species contaminant levels presented here were derived from species located at or near contaminated sites and should not be construed as representative of typical, background contaminant levels. The contaminant data were quantitatively represented for the three classes of substances metals, organochlorine pesticides, and PCBs by developing the series of contamination scenarios listed below. PAH contamination was not quantified in this way because the data did not indicate significant contamination in unprocessed resources other than fish and shellfish. (PAHs may be found at higher concentrations in processed, grilled, or smoked foods. However, the presence of PAHs from these activities was not considered in this work because the compounds are introduced in the food preparation process and are not a result of environmental contamination.)

Table 1: Contamination levels in potentially consumed species associated with hazardous waste contaminated sites[1]

Chemical Category	Resources in which Found	Substance	Concentration Range[2] (μg/g)
metals	shellfish, fish; leafy vegetables; fruits; shellfish, fish organ; meat, fish, poultry[4]; fish; shellfish in general; oysters; aquatic plants	arsenic cadmium cadmium cadmium lead mercury mercury mercury mercury	0.02 - 5; as high as 170[3] 0.02 - 0.06 (avg. 0.03) trace - 0.09 (avg. 0.02) 1.0 trace - 0.16 0.1 - 0.75 (avg. 0.4) 0.3 0.72; as high as 6.6 4.1 - 19.0
organochlorine pesticides	oysters; shrimp; fish; seal; polar bear; fruits; stem vegetables; wildlife near orchards[6]	chlordane dieldrin DDT[5] DDT[5] DDT[5] DDT[5] DDT[5] DDT[5]	0.65 - 292 (avg. 14.1) 0.05 - 9.5 (avg. 1.6) 0.06 - .82; as high as 3.77 1.5 0.27 0.01 0.02 22.0
PAHs	fish, seafood	total PAHs	2 - 2.5 and less
PCBs	fish; fish, polluted waters; muscles, oysters; waterfowl; herring gulls; dolphins	total PCBs total PCBs total PCBs total PCBs total PCBs PCB toxicity equivalents	0.53 - 0.85[7]; 1.3 - 4.1; some > 10.0[8] 0.01 - 6.81 0.1 - 35.1 100 - 200 1.5 - 9.5[9]

[1]Derived from ATSDR toxicological profiles.
[2]Contaminant levels were frequently provided without statistical parameters.
[3]In this case, metal contamination may be from food processing.
[4]Arsenic in fish may be organic. However, one study suggests that 0.1% - 41% of the arsenic in fish may be inorganic.
[5]Includes DDT, DDE, and DDD.
[6]Birds and mammals sampled near orchards in Washington State.
[7]A range of geometric means from different studies. Includes some salmon.
[8]Some salmon had comparable levels. PCB levels as high as 80 μg/g were found.
[9]Only a few samples were reported.

The following scenarios were developed from national hazardous waste site data and run independently in a Monte Carlo framework to represent potential metal, organochlorine, and PCB contamination in resources:

1. Metal concentrations were assumed to vary uniformly from 0.02 - 5 μg/g in marine invertebrates (shellfish), non-salmon fish, and salmon to account for potential arsenic, cadmium, and mercury contamination. This assumption did not account for high levels of arsenic found in some fish, noted in the table as potentially being of the less toxic organic form. (Each resource--marine invertebrates, non-salmon fish, and salmon-- was evaluated independently, so this range was used for three scenarios.)
2. Metal concentrations were assumed to vary uniformly from 4.1 - 19 μg/g in vegetation (aquatic plants) to account for potential mercury contamination. Whether harvested

vegetation in general could contain mercury levels similar to those found in the aquatic plants from which this range was derived is arguable.

3. Pesticide concentrations were assumed to vary according to a triangular distribution with a minimum value 0.65, maximum value 292, and most likely value 14.1 μg/g in marine invertebrates (shellfish) to account for potential chlordane contamination.
4. Pesticide contamination was assumed to be 1.5 μg/g in marine mammals (seal) to account for potential DDT contamination. Whether other marine mammals in general could contain DDT at levels similar to those found in the seals from which this value was derived is arguable.
5. Pesticide contamination was assumed to be 22 μg/g in large land mammals based on DDT contamination found in mammals near orchards where DDT was heavily used. Large land mammals were selected here because they were reported to be harvested generally at a higher rate than small land mammals and birds, the other types of resources included in the orchard study. The available information on this study did not detail whether DDT concentrations were actually found at these concentrations in large land mammals like those harvested in Alaska.
6. PCB concentrations were assumed to vary according to a triangular distribution with a minimum value 1.3, maximum value 80, and most likely value 4.1 μg/g in non-salmon fish.
7. PCB concentrations were assumed to vary according to a triangular distribution with a minimum value 1.3, maximum value 10, and most likely value 4.1 μg/g in salmon. The maximum value was reduced to 10 μg/g from the PCB/non-salmon fish scenario (#6) because the information reviewed indicated that concentrations of PCBs in salmon were generally somewhat less than concentrations in other types of fish.
8. PCB concentrations were assumed to vary uniformly from 0.1 - 35.1 μg/g in migratory birds (waterfowl).
9. PCB concentrations were assumed to vary uniformly from 100 - 200 μg/g in other birds (herring gulls). Whether other harvested birds could contain PCBs at levels similar to those found in the herring gulls from which this range was derived is arguable.

2.2.6 Evaluating potential contaminant exposure

The distributions for resource contamination and the distributions found in the goodness-of-fit process for resource harvest were loaded into Excel spreadsheets using Crystal Ball. Formulae for computing the consumption of all resources were entered to estimate resource consumption in grams per day from the harvest data; yearly per capita values were divided by 365 days to arrive at daily values. Formulae were also entered to estimate daily contaminant consumption in micrograms per day.

Crystal Ball was used to perform Monte Carlo analysis to estimate per capita daily harvest and daily contaminant consumption rates. The analysis also generated distributions of harvest rates for each resource in each of the five Ecological-Cultural regions. One thousand random samples trials were conducted for all analyses using the best-fit distributions for the resources. Runs were also made using the log-normal distribution for each of the resources to determine if the selection of the distribution affected harvest rate estimation and if the log-normal distribution could be effectively substituted for other less familiar distributions. (Contamination was not evaluated using the log-normal distributions for comparison.) All distributions were evaluated at the 50th and 90th percentile. Resource harvest distributions were also evaluated at the 95th percentile. For calculations including concentrations of chemical substances in resources, only resources identified from the toxicological profiles as being susceptible to contamination were considered because they were the ones for which environmental and chemical contamination information was readily available.

3.0 Results and Discussion

3.1 Task 1 Results and Discussion

3.1.1 The Use of Per Capita Data

Calculating total pounds harvested is a meaningful process for estimating the relative importance of different resources overall, but total pounds harvested may, to a great degree, be determined by population size. Regions with many people may have large numbers of persons harvesting few pounds of a resource and still have a large total harvest. As an alternative to the use of total pounds harvested, using per capita harvest rates makes it easier to identify regions or communities harvesting large amounts of a particular resource on a per individual basis, an important consideration for risk assessment. For this reason, we report results based on per capita analyses.

3.1.2 The Three Regional Classification Schemes

Although IDM identified seven regional classification schemes included in the Community Profile Database, examination of each scheme revealed that there were three classification schemes of primary interest. Each classification scheme divided the state into regions based on particular criteria. The three subsistence classification schemes are summarized in Table 2, and are presented, along with descriptive information, as Figures 1-3 in *Appendix A*.

Table 2: The Three Regional Classification Schemes

Regional Scheme	Criteria	Number of Regions
Ecological-Cultural Regions	predominant Alaska Native culture	5
Federal Subsistence Regions	geographic location within Federal subsistence management regions	10
Alaska Department of Fish and Game (ADFG) Regions	jurisdiction of Regional Subsistence Councils of the ADFG	6

These three classification schemes were selected because they divided the state into a reasonable number of regions and because they seemed the most likely ones to provide regions with unique harvesting and consumption characteristics. Three of the four other classification schemes grouped communities into too many regions for screening purposes--16 or more. (Large numbers of regions result in some regions not having any communities harvesting certain resources.) The fourth scheme was based on wildlife conservation, and IDM could not locate sufficient information in the database to support analysis on this classification scheme. A list of villages and the regions they fall in according to each of the three regional classifications is provided in *Appendix A*.

It is worth noting that these boundaries are arbitrary. The ADFG and Federal subsistence boundaries were established to assure appropriate representation on regional councils. Defining the region in which a community is located has not been a problem according to USFW. It could be a problem if one is applying regional harvest assumptions to a specific community. For example, Pt Hope is located in a Kotzebue Sound Game Management subunit, but is classified with the North Slope Subsistence Resource Region by the Federal Subsistence Management System because they harvest similar species. Anaktuvuk Pass has another problem. The boundary between two game management units divides their community. Although neither of these examples affects the boundaries of the three systems we selected for further analyses, they illustrate potential problems with definition. Thus, while contaminant exposure scenarios can be generated and applied when specific data are lacking, consideration of any information on harvest and/or consumption practices in a specific community is prudent.

3.1.3 Harvested Resources

Using existing database resource groups, IDM determined that all resources could be sorted into the following categories:

- salmon and non-salmon fish;
- large land mammals, small land mammals, and feral animals;
- marine mammals;
- migratory birds, other birds, and bird eggs;
- marine invertebrates; and
- vegetation.

The resource categories, including species, are defined in *Appendix B: Definitions*. These categories were selected because they seemed large enough to be useful for screening and because they could still be used to separate out resources that would have the greatest potential to accumulate environmental contaminants: non-migratory animals, animals with small ranges, and vegetation.

To help identify which resources are most harvested in the State of Alaska, IDM ranked the resources based on total pounds harvested (Table 3). Total pounds harvested was calculated for each resource as the sum across all communities of the values in the database field *xtotlbs* (Table dat:harvest). Average annual per capita harvest histograms for the ADFG, Ecological-Cultural and Federal subsistence regional classifications are presented in *Appendix F.*

3.1.4 The Most Harvested Resources by Region

To help identify an effective regional classification system based on harvest characteristics, IDM developed a series of tables focusing on the most harvested resources in each of the regions defined by the three schemes. *Appendix C* contains tables listing each of the regions in the three regional schemes and the regional per capita harvest for each resource. *Appendix D* contains tables listing the five most harvested resources by per capita pounds for each region in each of the three regional classification schemes. (The last column in each Table in *Appendix D* summarizes the total per capita harvest for each region, as listed in *Appendix C*.) *Appendix E* contains tables listing the significance of the resources as related to per capita harvest. Significance was measured in this case by the number of times a particular resource was ranked first, second, third, fourth, or fifth. Significance of the resources was considered for all three of the regional classification schemes together and for each of the schemes individually.

Five resources (salmon, non-salmon fish, large land mammals, marine mammals, and marine invertebrates) represent, at minimum, 89% of each region's total per capita harvest (derived from *Appendix C*). These five resources occupied nearly 93% of the top four rankings and over 78% of the top five. (The vegetation resource also appeared in the top five frequently, but it was never ranked higher than fifth.) These five resources also comprise 94% of the total pounds harvested for the state, regardless of regional classification scheme (Table 3).

In calculating regional per capita harvest rates it became evident that weighting regional per capita computations by population would obscure the harvest behaviors of small communities. In fact, some communities harvest much more of certain resources than their corresponding regional per capita rates would indicate. This variability is evident in the tables in *Appendix C* in the columns listing the minimum and maximum per capita harvest rates for each resource in each region. The variability may also be seen in the histograms presented in *Appendix F* which compare community per capita resource harvest rates within each regional classification.

Table 3: Resources Ranked according to Total Pounds Harvested

Resource	Total Pounds Harvested
Salmon	8,680,674
Non-Salmon Fish	5,581,788
Large Land Mammals	4,851,733
Marine Mammals	2,597,173
Marine Invertebrates	1,146,420
Vegetation	562,539
Migratory Birds	397,857
Small Land Mammals	317,488
Other Birds	88,301
Feral Animals	51,676
Bird Eggs	18,181

3.1.5 Parametric and Non-Parametric Analyses

IDM used both parametric and non-parametric ANOVA (i.e., Kruskal-Wallis) to evaluate which regions and resources required pairwise analysis. Parametric analyses were conducted for the top five resources: salmon, non-salmon fish, marine mammals, marine invertebrates, and large land mammals. Non-parametric analyses were conducted for all eleven major resource categories including: salmon, non-salmon fish, large land mammals, small land mammals, marine mammals, feral animals, marine invertebrates, migratory birds, non-migratory birds, bird eggs and vegetation.

Following parametric ANOVA analysis, only two incidences were identified at α=.05 where the intra-regional per capita harvest rates were all equal: for salmon within the Ecological-Cultural regional classification and for large land mammals within the ADFG regional classification; in these cases no pairwise comparisons were carried out. All other ANOVA results indicated that the regional per capita harvest rates were not all equal at α=.05, indicating that pairwise t-test comparisons should be performed.

Non-parametric ANOVA analyses demonstrated that all but one of the regional classification schemes for all resource categories had intra-regional differences in per capita harvest rates. The one case where Kruskal-Wallis ANOVA could not identify intra-regional differences in per capita harvest was for feral animals within the Ecological-Cultural classification; all other cases were evaluated using pairwise Mann-Whitney U non-parametric statistics. The results of the non-parametric analyses are presented as *Appendix G.*

As mentioned in *Methods*, *2.1.3 Pairwise Comparisons,* IDM evaluated all t-test and Mann-Whitney U results using the Bonferroni correction method to determine if correcting for the increasing likelihood of Type I errors would change the conclusions of the analysis. It was selected because it is the most conservative correction method available. Applying it changes the number of significant differences found both parametrically and non-parametrically (see *Appendix G*). However, its application does not change the conclusions as to which regional scheme is best (see *Appendix H*). By examining how the regional rankings might change both with a very conservative multiple comparison correction and without the use of multiple comparison correction, it was possible to evaluate whether the selection of multiple comparison correction methods would alter the choice of regional classification.

3.1.6 Regional Classification Rankings

Tables 4 and 5 summarize the results for the parametric analysis and non-parametric analysis, respectively. In the parametric case, the ADFG regional classification performed best overall. In the non-parametric case, the Ecological-Cultural regional classification best discriminated between regions in their per capita harvest rates (*Appendix H*). Because the data do not appear to be consistently distributed in a parametric manner, IDM selected the Ecological-Cultural regional system for classifying Alaskan Native communities.

IDM looked at the percentage of differences calculated across all comparisons (not just within resource); the average of the percentage of differences for the resources; and the number of times a regional scheme was ranked first. IDM also evaluated the three regional schemes non-parametrically for all eleven resources even though resources harvested at low levels should probably not be used to define regional differences. None of these approaches changed the conclusions of the original analysis (see Table 26 and Table 27, *Appendix H*).

Table 4: Ranking of the Regional Schemes Based on Parametric Analysis

Resource	Eco-Cultural Regions	ADFG Regions	Federal Sub. Regions
Salmon	3	1	2
Non-Salmon Fish	1	2	3
Large Land Mammals	2	3	1
Marine Mammals	3	1	2
Marine Invertebrates	1.5	1.5	3
Total	10.5	8.5	11

Table 5: Ranking of the Regional Schemes Based on Non-Parametric Analysis

Resource	Eco-Cultural Regions	ADFG Regions	Federal Regions
Salmon	2	1	3
Non-Salmon Fish	1	2	3
Large Land Mammals	1	3	2
Marine Mammals	2	1	3
Marine Invertebrates	1	3	2
Total	7	10	13

3.2 Task 2 and Task 3 Results and Discussion

3.2.1 Subsistence consumption analysis

The number of person-days for which consumption surveys were collected in each season is shown in Table 6. Each person's participation in a season was considered an independent person-day.

Table 6: Number of Person-days of Dietary Interviews from Alaska Natives, 1987-1988

Community	Winter	Spring	Summer*	Fall
"A"	18	27	35	10
"B"	5	22	8	1
"C"	15	9	6	10
"D"	22	24	22	20
"E"	26	26	47	23
"F"	29	27	47	25
"G"	21	20	36	17
"H"	21	23	27	9
"J"	28	28	42	20
"K"	28	26	48	26
"L"	12	18	20	23

*Interviews conducted in Summer,1987 and Summer 1988. Other interviews conducted in 1988.

While salmon was the principally consumed resource in most surveyed communities (Appendix K), non-salmon fish, large land mammals and marine invertebrates were also observed to be the dominant resource in some communities. In general, the major resources consumed are similar to those reportedly harvested in the CPDB (Appendices C and D).

Because berries were of special interest they were evaluated both as part of the resource classification "vegetation" and separately. Appendix K illustrates that berries may be consumed in greater amounts than are other vegetation. Seaweed was the plant consumed in notable quantity in a few communities. But when ranked by per capita consumption, berries and plants didn't rank higher than third in any community (Appendix K).

Seasonal differences were observed in resource consumption in each community (Appendices M and N). Because of seasonal trends in resource consumption, ADEC should consider seasonal affects when examining potential contaminant exposure through resource consumption.

The data from the dietary investigation (Nobmann et al, 1992) provide the latest, most geographically varied direct information on intakes of Alaska Native adults. Intakes from four seasons are included. Information was obtained on total diet in an open-ended format thus, information on consumption of specific foods is included. The design of the dietary investigation attempted to minimize the recognized limitations of all dietary surveys. This was done by conducting standardized training for interviewers, randomly selecting participants, and interviewing participants in their home where portion sizes could more easily be estimated. Approximately 80% of the Alaska Native population live in the regions included in the investigation.

The original data are available and were used for verification of the database on the computer when necessary. The principal investigator of the original investigation analyzed the data for the investigation presented here.

As with any dietary investigation, there are several limitations to the interpretation of information presented as part of this investigation. Importantly, communities included in the consumption survey do not represent all areas of the state, nor can they be reasonably assumed to represent regional dietary trends because of their limited number. Data were not collected in communities of the North Slope, Interior, or Aleutian Island Chain. Because of the limited number of communities selected, it may be anticipated that had different communities been invited to participate in providing consumption information, different results would have been obtained. For these reasons we did not attempt to extrapolate community consumption to the appropriate Ecological-Cultural region.

Extrapolating information from data on individuals to annual community intakes has limitations. The number of people interviewed in some communities in some seasons was limited (Table 6). Because of the limited number of surveys in some communities in some seasons, the consumption rates are statistically unstable; extremely large servings by one person on one day may magnify the estimated consumption for the community for the entire season (Chan *et al.*, 1997). Lacking more extensive data, we assumed that every one of the 91.25 days in a season is equal to the one set of person-days for which we have data despite the fact that eating patterns may vary within a season.

It is possible that differences among communities may be due to one interviewer conducting all interviews in one community, but we consider this is an unlikely source of variation as interviewers underwent standardized training in interview techniques.

3.2.2 Comparison of subsistence consumption rates and harvest rates

The results of correlation analyses between harvest and dietary intakes are shown in Tables 7 and 8.

Table 7: Correlation and regression slope of per capita rates of harvest and consumption (lbs/yr) among all resources by community

Community	Slope	Correlation	R^2	N
"A"	0.35	0.75	0.56	11
"C"	0.31	0.91	0.82	11
"D"	0.20	0.95	0.90	11
"F"	0.49	0.93	0.86	11
"H"	0.88	0.91	0.83	11
"J"	0.55	0.70	0.50	6
"L"	3.03	0.99	0.98	3

Table 8: Correlation and regression slope of per capita rates of harvest and consumption (lbs/yr) among all communities by resource

Resource Code	Resource	Slope	Correlation	R^2	N
110000000	Salmon	0.20	0.45	0.20	6
120000000	Non-Salmon Fish	0.34	0.96	0.91	6
210000000	Large Land Mammals	0.24	0.82	0.67	6
220000000	Small Land Mammals	0.35	0.97	0.94	6
230000000	Feral Animals				0
300000000	Marine Mammals	0.71	0.49	0.24	7
410000000	Migratory Birds	1.07	0.93	0.87	7
420000000	Non-Migratory Birds	0.51	0.85	0.73	6
430000000	Bird Eggs	0.27	0.11	0.01	5
500000000	Marine Invertebrates	0.67	0.67	0.45	5
600000000	Vegetation (incl. Berries)	0.59	0.35	0.12	5
601000000	Berries	3.34	0.94	0.88	5

The correlation analyses between harvest and consumption data by community reveals generally strong linear relationships (Table 7 and Appendix L). As expected, quantities harvested were generally greater than quantities consumed. Greater harvest than consumption may be explained, in part, by differences in definition of resources, by differences in reporting and scaling and other assumptions used to derive the reported rates, and by the use of resources for other purposes than food for humans. If any harvested resources are shared outside the community, harvest data would overestimate the community intake values. Edible pounds of wild resources as defined by CPDB may include bones of particular species and other products that are not consumed, in contrast to the pounds in the dietary analyses that do not include inedible parts. Although community "L" had approximately 3 times consumption relative to harvest, information was available only for resources associated with birds (i.e., migratory birds, non-migratory birds, and bird eggs), and may not be very stable (see Appendix K). The correlation between harvest and consumption of bird eggs is generally very poor (Table 8).

When the ranked resources from harvest and consumption data are compared, many similarities are apparent, such as highly ranked salmon, non-salmon fish, and large land mammals (Tables 19 and 28).

In the analyses presented here, consumption was greater than harvest values for a few resources (Table 8 and Appendix K). This may be explained for berries and plants by the inclusion of purchased berries as well as harvested berries in the consumption data. Greater consumption than harvest of bird eggs may be explained by the substitution of weights for domestic duck and goose in the consumption database, lacking information on the weight of locally obtained bird eggs that the harvest database might use. The harvest data do not account for foods harvested elsewhere coming into the community, and may explain the few comparisons where sea mammal consumption values exceeded harvest values.

It is worth noting that the two databases calculate per capita consumption in different ways. The CPDB divides the total community estimated edible pounds of the wild resource harvested by the estimated total number of people living in the community. The dietary database describes intakes of only men and women 21-60 years of age. Children included in the community denominator by the CPDB may be less likely to eat harvested foods and would eat smaller amounts than older children and adults. Thus harvest data overestimates use for some individuals within the community and underestimates for others. The consumption data are likely to more accurately reflect true dietary patterns in the few communites for which they are available, but only for adults 21-60 years of age.

Harvest and consumption may vary from year to year. An ideal comparison of the two sources would be based on data collected for the same years. Data reported here represent harvest and consumption information collected in different years for four of the seven communities compared (D, F, J, L). In two of the paired communities (C, H), harvest data from 1987 and one other year were averaged, and compared to consumption data from 1987 only. In community A, both harvest and consumption data were collected in 1987.

The inherent variations in results associated with interviewing techniques, memory of respondents and assumptions about portion size may affect both the dietary and harvest data. Collection of harvest data in Alaska may involve additional challenges. The quality of harvest data in general was the subject of a 1995 conference that brought together more than two hundred government managers, subsistence users, data collectors, and researchers from Alaska, Canada and Greenland. They gathered to talk about harvest assessment problems and potential solutions (Alaska Department of Fish and Game, Institute of Social and Economic Research, 1996). Several suggestions came from the conference to address the issues and help those involved in harvest assessment in the North understand the points of view of others. The fact that such a conference was held illustrates concerns in Alaska about the issues of harvest assessment; these concerns may affect the quality of the harvest data used here. Because of the inter-relationship between reporting of harvest resources and the assessment of contaminant exposure through subsistence resource consumption, there is a need for a process that assesses potential resource contamination independent of the assessment of subsistence harvest rates.

Finally, when considering the potential for hazardous substances in resources it may be necessary to consider the life history of the species. Each species may spend different amounts of time feeding in an area that may contain variable amounts of contaminants or hazardous substances (Appendix O).

3.2.3 Regional intercommunity harvest distributions

Table 9 compares the parameters of the best fit and log-normal distributions for the harvest data, based on the results of the Kolmogorov-Smirnov test. The distributions are explained in Appendix P.

The community harvest data, in general, do not fit any of the tested distributions uniquely or particularly well. According to the Crystal Ball software, a test value < 0.03 is necessary to indicate a close fit. None of the data sets yielded Kolmogorov-Smirnov test values less than 0.03.

Table 10 presents the results of the Monte Carlo analysis for per capita daily harvest and for the harvest rates for the top five resources as determined in Task 1. It lists the results of the best fit and log-normal distribution runs evaluated at the 50th, 90th, and 95th percentiles of the output distributions. As evident in Table 10, the log-normal distributional runs do not consistently overestimate or underestimate the best-fit distributional runs. Moreover, there are greater disparities among the 90th and 95th percentile estimates than the 50th percentile estimates. The best-fit and log-normal predicted values failed to match within 20% in the following cases:

- per capita daily harvest in region 1 at the 90th and 95th percentiles;
- per capita daily harvest in region 2 at the 95th percentile;
- salmon harvest in region 1 at the 50th, 90th, and 95th percentiles;
- non-salmon fish harvest in region 5 at the 90th and 95th percentiles;
- large land mammal harvest in region 1 at the 50th, 90th, and 95th percentiles;
- large land mammal harvest in region 2 at the 95th percentile;
- large land mammal harvest in region 4 at the 95th percentile;
- large land mammal harvest in region 5 at the 50th and 95th percentiles;
- marine mammal harvest in region 1 at the 90th and 95th percentiles;
- marine mammal harvest in region 4 at the 90th and 95th percentiles;
- marine mammal harvest in region 5 at the 50th, 90th, and 95th percentiles;
- marine invertebrate harvest in region 1 at the 50th, 90th, and 95th percentiles;
- marine invertebrate harvest in region 3 at the 50th, 90th, and 95th percentiles;
- marine invertebrate harvest in region 4 at the 90th and 95th percentiles; and
- marine invertebrate harvest in region 5 at the 90th and 95th percentiles.

Salmon is certainly the dominant resource harvested throughout the state. The best fit results from Table 10 evaluated at the 50th percentile indicate that salmon is the number one resource harvested in all five regions. The results are similar when evaluated at the 90^{th} percentile, except in Region 5 where large land mammal harvest is the largest.

In examining Table 10, it is important to review the 50^{th}, 90^{th} and 95^{th} percentiles in order to better understand the characteristics of the communities' harvest rates as modeled. The 50^{th} percentile may reflect more generally the harvest rate for communities in a region. However, the 90^{th} and 95^{th} percentiles are important because they may indicate the presence of a few communities in a region harvesting a particular resource at a higher rate than expected.

Table 9: Comparison of Best Fit Distributions and Log-normal Distributions*

	Arctic Subarctic	Aleutian Pacific	Subarctic Interior	SE AK Coast	Urban
Salmon	EVD(128.9, 133.3), 0.1058 LN(528, 2973), 0.2663	B(2.7, 11.7, 645.8), 0.0790 LN(122, 73.6), 0.1203	LN(238, 711), 0.1330	G(13, 27.6, 2.1), 0.0660 LN(71.5, 42.9), 0.0739	W(14.5, 23.5, 1.5), 0.1256 LN(35.7, 14.2), 0.1414
Non-Salmon Fish	W(10.7, 94.2, 0.78), .0714 LN(119, 171), 0.0893	EVD(48.8, 25.6), 0.1491 LN(65.2, 41.4), 0.1579	LN(48.8, 68.6), 0.0839	LN(66.8, 37.8), 0.0797	LG(17.4, 4.13), 0.1440 LN(18.3, 11.9), 0.2305
Large Land Mammals	B(1.2, 3.2, 477.4), 0.0744 LN(184, 339), 0.1356	W(-2.1, 45, 1.1), 0.1124 LN(47.4, 58.2), 0.1385	LN((87.6, 57.9), 0.0962	EVD(44.7, 28.2), 0.1131 LN(65.3, 56.8), 0.1636	G(10.5, 70.7, 0.43), 0.1567 LN(40.3, 38.8), 0.1804
Marine Mammals	B(.43, 3.8, 1288), 0.1136 LN(298, 1811), 0.1599	G(.57, 69.7, 0.41), 0.0844 LN(37.6, 137), 0.0976	Only One Value Available: 2.56	EVD(2.54, 4.92), 0.2358 LN(10.5, 19), 0.4034	LG(.11, 0.31), 0.4096 LN(4.4, 110), 0.7299
Marine Invertebrates	W(0, 2.6, 0.64), 0.1476 LN(5, 14.5), 0.2291	B(2.6, 10, 89.7), 0.0583 LN(18.8, 12.3), 0.1095	N(.42, 1), 0.3414 LN(1.3, 3.5), 0.6295	EVD(26.5, 19.1), 0.0768 LN(43.8, 52.7), 0.1638	W(-.2, 4.5, 0.9), .1772 LN(6.2, 12.6), 0.2415
Vegetation	LG(14.1, 6.5), 0.1020 LN(20.8, 39.1), 0.1833	B(2.3, 2.6, 14.2), 0.0674 LN(6.9, 3.5), 0.1231	W(1.7, 5.9, 1.1), 0.0696 LN(7.4, 5.5), 0.0912	LN(9.8, 7.7), 0.0909	W(1.5, 4.5, 0.9), 0.1759 LN(6.1, 4.7), 0.1890
Migratory Birds	LN(13.9, 17.1), 0.0597	W(-.2, 4.3, 1.1), 0.0899 LN(4.6, 6.2), 0.1151	LN(6.6, 24.0), 0.1410	LN(3.2, 4.6), 0.1408	W(-.1, 0.7, 1.1), 0.1511 LN(.7, 0.7), 0.2177
Small Land Mammals	B(.3, 1.0, 57.5), 0.0771 LN(50.1, 617.1), 0.1183	EVD(.3, 0.3), 0.1352 LN(.7, 0.9), 0.2719	LN(13.3, 29.5), 0.0801	LG(0, 0.1), 0.4531 LN(.7, 0.5), 0.90	B(.3, 0.8, 5.8), 0.2045 LN(1.9, 4.2), 0.2146
Other Birds	W(-.1, 2.6, 1.1), 0.0849 LN(3.5, 7.4), 0.0994	LN(1.2, 3.6), 0.0944	B(1.6, 10.0, 15.5), 0.0782 LN(2.2, 2.0), 0.1058	W(0, 0.1, 0.6), 0.1468 LN(.3, 1.2), 0.1992	EXP(.5), 0.1410 LN(1.8, 1.8), 0.2225
Feral Animals	N(5.3, 4.7), 0.2602 LN(5.4, 4.6), 0.3413	EVD(3.3, 14.3), 0.4011 LN(52.3, 856.8), 0.4708	No Data	No Data	Only One Value Available: .11
Bird Eggs	B(.5, 6.5, 16.1), 0.1304 LN(2.4, 9.3), 0.1759	B(.4, 4.7, 12.8), 0.1046 LN(1.5, 4.6), 0.1841	LG(0.01, 0.06), 0.4661 (rounded) LN(.3, 1.6), 0.8438	LG(0.01, 0.04), 0.4164 (rounded) LN(.2, 0.1), 0.80	Only One Value Available: .04

* Data presented as annual per capita harvest in pounds. Each cell contains the best fit distribution and log-normal distribution fits (distribution parameters), Kolmogorov-Smirnov fit. K-S values < 0.03 are considered a close fit. When only one distribution is provided, the best fit is a log-normal fit. All distributions were truncated at zero to exclude any negative values.

Distributions evaluated include:
B = Beta distribution (alpha, beta, scale); EVD = Extreme value distribution (mode, scale); EXP = Exponential distribution (rate)
G = Gamma distribution (location, scale, shape); LG = Logistic distribution (mean, scale); LN = Log-normal distribution (mean, standard deviation)
N = Normal distribution (mean, standard deviation); W = Weibull distribution (location, scale, shape)

Table 10: Results of Monte Carlo Analysis

		Arctic-Subarctic (Region 1)		Aleutian Pacific (Region 2)		Subarctic Interior (Region 3)		SE AK Coast (Region 4)		Urban (Region 5)	
(All numbers in grams/day)		Best Fit	LN	Best Fit	LN	Best Fit	LN	Best Fit	LN	Best Fit	LN
Per Capita Daily Harvest	95th Percentile	1474.5	4195.3	591.0	811.5	1405.5	1379.4	489.9	573.2	277.6	244.0
	90th Percentile	1253.5	2722.3	544.3	639.8	925.2	928.3	440.3	488.1	214.0	212.4
	50th Percentile	767.2	808.2	376.9	370.6	335.2	315.7	312.8	315.8	120.8	132.7
Salmon Harvest	95th Percentile	525.7	1803.9	235.1	254.8	987.9*	905.0*	151.9	153.4	60.4	61.7
	90th Percentile	437.8	1114.9	210.5	214.1	542.9*	560.2*	127.8	129.2	54.4	53.9
	50th Percentile	193.8	100.7	118.1	106.9	76.8*	70.2*	61.3	62.1	32.4	33.3
Non-Salmon Fish Harvest	95th Percentile	351.3	342.1	120.4	138.2	149.6*	155.7*	136.1*	146.0*	28.5	41.5
	90th Percentile	262.8	248.1	106.9	115.6	112.7*	107.2*	115.8*	118.4*	25.7	32.9
	50th Percentile	63.6	70.2	58.8	54.0	27.8*	29.1*	57.1*	58.4*	17.0	15.4
Large Land Mammal Harvest	95th Percentile	314.3	655.4	118.9	147.6	199.5*	195.8*	130.6	161.2	147.6	107.4
	90th Percentile	263.7	421.4	91.0	107.8	164.5*	160.5*	109.8	121.3	103.1	84.0
	50th Percentile	114.3	90.4	29.8	32.1	76.1*	74.3*	56.9	49.6	23.8	30.4
Marine Mammal Harvest	95th Percentile	533.0	1017.0	114.8	126.6	2.6**	2.6**	19.1	33.2	1.2	9.5
	90th Percentile	369.0	550.0	78.8	77.4			15.0	21.2	0.9	4.1
	50th Percentile	60.4	50.0	11.2	10.0			5.8	4.9	0.4	0.2
Marine Invertebrate Harvest	95th Percentile	12.3	17.2	38.0	38.6	2.2	4.6	84.8	150.0	16.0	22.1
	90th Percentile	8.1	10.0	32.4	32.4	1.9	2.7	68.6	105.8	12.1	15.5
	50th Percentile	1.3	1.7	17.2	15.7	0.8	0.5	33.0	29.9	3.0	2.7

* In these cases, the Kolmogorov-Smirnov test indicated that a log-normal curve best fit the data. Therefore, any differences between the best fit column and the log-normal column are due to random number selection.
** Only one community reported harvesting marine mammals in this region.

3.2.4 Sensitivity of exposure estimates to major resources

Table 11 lists the results of the Monte Carlo analysis for the equations estimating daily contaminant consumption, as derived from the series of bioaccumulation scenarios described in the Methods section. The table presents the 50th and 90th percentiles of the output distribution calculated for each region. All calculations were based on the best fit distributions. (PAHs were not included in this analysis because available bioaccumulation data indicated that fish and shellfish were the primary concerns for PAHs.) Table 12 summarizes these results, highlighting the most significant resources for each region based on the scenarios developed. A review of Tables 11 and 12 along with Table 1 indicates that salmon is a potentially important resource to consider for certain kinds of contamination, but that the other major resources, vegetation, and certain types of birds may also be very important depending upon the types of contaminants present and the harvest patterns of the communities nearby.

Table 11: Monte Carlo Results for Daily Contaminant Consumption (mg/day)

Bioaccumulation Scenarios Contaminant Concentration Ranges (mg/g)	Arctic-Subarctic	Aleutian Pacific	Subarctic Interior	SE AK Coast	Urban
metals: 0.02-5 (marine invertebrates)	26.3[1] 3.4[2]	119.9 44.1	7.1 2.1	255.7 86.6	39.3 7.4
metals: 0.02-5 (non-salmon fish)	946.8 168.0	409.6 166.3	342.7 73.7	425.7 157.9	108.1 47.3
metals: 0.02-5 (salmon)	1646.9 489.1	839.0 319.1	1600.6 204.0	466.2 162.8	228.3 98.5
metals: 4.1-19 (vegetation)	469.8 205.9	186.9 84.6	234.5 77.5	280.1 102.1	194.3 60.1
pesticides: 0.65-292 average 14.1 (marine invertebrates)	1311.2 123.0	5052.5 1632.4	315.6 74.9	10,571.4 3313.8	1709.3 288.8
pesticides: 1.5 (marine mammals)	717.8 103.3	146.5 21.5	4.78 constant	28.2 10.6	1.7 0.7
pesticides: 22 (large land mammals)	7061.5 2956.8	2417.1 874.3	4167.7 1959.9	2927.6 1511.9	2593.0 658.6
PCBs: 1.3-80 average 4.1 (non-salmon fish)	10,837.5 2059.7	4657.3 1696.7	4062.0 805.8	5316.8 1827.3	1350.0 493.8
PCBs: 1.3-10 average 4.1 (salmon)	2884.3 1082.0	1472.2 667.6	3193.7 466.3	837.6 390.1	397.8 198.5
PCBs: 0.1-35.1 (migratory birds)	763.8 157.7	227.6 48.9	334.9 31.5	152.5 30.4	36.7 8.6
PCBs: 100-200 (other birds)	1034.0 332.0	492.1 63.9	767.7 308.3	95.7 14.9	847.1 253.1

[1]90th percentile value
[2]50th percentile value

Table 12: The Most Significant Resources for Three Categories of Contaminants

	Arctic-Subarctic	Aleutian Pacific	Subarctic Interior	SE AK Coast	Urban
metals	salmon vegetation[1]	salmon	salmon	salmon	salmon
pesticides	large land mammals marine invertebrates[2]	marine invertebrates large land mammals[2]	large land mammals	marine invertebrates large land mammals[2]	large land mammals marine invertebrates[2]
PCBs	non-salmon fish salmon[2] other birds[1]	non-salmon fish salmon[2]	non-salmon fish salmon[2]	non-salmon fish	non-salmon fish other birds[1]

[1]Although this resource is not greatly harvested, certain substances may bioaccumulate in it at relatively high concentrations. Therefore, even moderate consumption of the resource as reported in this region could be interest.
[2]The results of the Monte Carlo runs and the harvest data suggest that consumption of this resource may lead to contaminant daily consumption rates greater than 1 mg per day within this region.

The compilation of Tables 11 and 12 required the synthesis of large amounts of information, the development of specific procedures, and the formation of a number of arguable assumptions. Key among these are the following:

1. Best fit distributions were used to represent harvest behaviors even though statistical analysis did not indicate a close fit.
2. The harvest data are assumed to be well correlated with and generally sufficient to represent reported consumption, although resource harvest may underestimate or overestimate consumption of any one resource.
3. In certain cases, bioaccumulation information on one segment of a resource category was extrapolated to the entire category. No tissue-specific information contaminant was evaluated.
4. The resource salmon was assumed to be nearly as susceptible to environmental contamination as other fish. This assumption was based on the results of PCB studies on the Great Lakes, as summarized in the ATSDR toxicological profiles, which indicated comparable, yet somewhat less, PCB contamination in certain species of salmon when compared to other fish.
5. The hazardous substances examined were assumed to accumulate in biological compartments readily eaten. In fact, substances may bioaccumulate in specific biological compartments of organisms that may not be regularly used for food.
6. Distributions for potential contaminant concentrations in resources were assigned for general guidance only. Actual contaminant concentrations in resources will depend on site-specific and contaminant specific factors.

Most of these assumptions and procedures were adopted to help identify areas of potential concern for certain types of exposure scenarios. The main exception was the use of the best fit probability density distributions. The best fit distributions were used by default because IDM could not identify a plausible alternative that could be applied within the scope of this project.

To quantify the significance of using these distributions, IDM produced Table 13 to compare the best fit 50th, 90th, and 95th percentile levels of the top five resources to the actual regional per capita and maximum per capita harvest rates determined in Task 1. (Regional per capita and maximum per capita harvest rates are presented in lbs/yr in Table 21, Appendix D.) The values presented in Table 13 have been converted to grams per day.

Table 13. Comparison of Harvest Rates (g/day)

Region	Resource	Regional Per Capita Harvest	50th Percentile Harvest	90th Percentile Harvest	95th Percentile Harvest	Maximum Harvest
Arctic-Subarctic	Salmon	177.9	193.8	437.8	525.7	834.6
	Non-Salmon Fish	146.7	63.6	262.8	351.3	830.1
	Large Land Mammals	124.6	114.3	263.7	314.3	507.0
	Marine Mammals	154.3	60.4	369.0	533.0	792.1
	Marine Invertebrates	2.3	1.3	8.1	12.3	28.9
Aleutian Pacific	Salmon	81.9	118.1	210.5	235.1	397.3
	Non-Salmon Fish	65.8	58.8	106.9	120.4	276.6
	Large Land Mammals	31.6	29.8	91.0	118.9	192.0
	Marine Mammals	8.1	11.2	78.8	114.8	191.1
	Marine Invertebrates	17.4	17.2	32.4	38.0	56.3
Subarctic Interior	Salmon	293.4	76.8	542.9	987.9	1988.4
	Non-Salmon Fish	63.5	27.8	112.7	149.6	445.4
	Large Land Mammals	105.5	76.1	164.5	199.5	470.5
	Marine Mammals	1.3	2.6	2.6	2.6	3.2
	Marine Invertebrates	0.8	0.8	1.9	2.2	5.6
SE AK Coast	Salmon	58.1	61.3	127.8	151.9	216.6
	Non-Salmon Fish	58.2	57.1	115.8	136.1	217.5
	Large Land Mammals	53.9	56.9	109.8	130.6	236.9
	Marine Mammals	6.1	5.8	15.0	19.1	45.6
	Marine Invertebrates	31.7	33.0	68.6	84.8	144.8
Urban	Salmon	32.1	32.4	54.4	60.4	82.6
	Non-Salmon Fish	27.7	17.0	25.7	28.5	37.4
	Large Land Mammals	22.8	23.8	103.1	147.6	146.7
	Marine Mammals	0.2	0.4	0.9	1.2	2.9
	Marine Invertebrates	12.1	3.0	12.1	16.0	20.8

Table 13 demonstrates two important points:

1. The 50th percentile levels are within a factor of two of the regional per capita harvest rates in 20 of 25 cases. They, therefore, seem reasonably well suited for an approximation of regional per capita harvest rates of the major resources.
2. The 95th percentile levels are at most 3.0 times below the maximum community harvest rates. In fact, they are within a factor of two of the maximum community harvest rates in 16 of 25 cases. (The simulated 95th percentile level does exceed the maximum harvest rate in one case by a factor of 1.006.) If the harvest rates slightly overestimate consumption, as the existing consumption data seem to suggest, the 95th percentile values may fairly represent many of those communities reporting maximum or near maximum harvest rates for a particular major resource in a region.

Whether the use of the best fit or log-normal distributions injects significant bias into the analyses is difficult to determine. However, if this element of uncertainty is undesirable, possible refinements are available. One option would be to build custom distributions representing observed fractiles of harvest/consumption of each resource within each region, or representing every individual data point. These custom distributions would more directly represent actual harvest data, and could be updated as the database changes over time. Significant limitations include the large amount of time associated with the development and use of a substantial number of these distributions, as well as the unclear potential of such a procedure for improving the harvest distributions.

4.0 Recommendations

Task 1: Because the data do not consistently fit a log-normal curve, IDM recommends using the results of the non-parametric analysis instead of the parametric. Therefore, IDM recommends using the Ecological-Cultural regional classification scheme as the basis for establishing risk assessment guidelines on consumption of locally obtainable resources.

Task 2 and Task 3: The methods used in these evaluations were designed to develop and demonstrate an approach for evaluating the significance of the harvested resources in the risk assessment process. From these analyses it is evident that the resources salmon, non-salmon fish, large land mammals, marine mammals, and marine invertebrates are generally harvested more than others. However, because environmental partitioning, tissue distribution (i.e., pharmacokinetics), tissue or organ consumption practices and food storage and preparation practices will affect exposure to chemical contaminants, contaminant-specific issues at hazardous waste sites may warrant analysis of less harvested resources, such as vegetation or birds.

Within this project, the resources have been ranked against one another to assess their relative importance in risk assessment. This information is perhaps most appropriately used to understand data gaps and to assist in establishing environmental sampling strategies most likely to inform assessors of site-specific risks. Because the real test of a resource's significance can only be measured in its likelihood to become contaminated and affect the health of the persons consuming it, the results summarized here are not an adequate substitute for site- or community-specific information regarding harvest, consumption, contamination, and the likelihood of health effects. Only when site-specific data are available can truly useful hypotheses be formed to estimate risks to public health.

References

Agency for Toxic Substances and Disease Registry. ATSDR's Toxicological Profiles on CD-ROM. 1997. Lewis Publishers, Boca Raton, FL.

Alaska Department of Fish and Game, Division of Subsistence (September 1996). Community Profile Database Technical Documentation Microsoft Access 2.0 Version. Juneau, AK

Alaska Department of Fish and Game, Institute of Social and Economic Research. Understanding Harvest Assessment in the North, synthesis of the conference on Harvest Assessment, April 20-22, 1995, Girdwood, Alaska. Anchorage, Alaska, March 1996.

Chan HM, Berti PR, Receveur O, and Kuhnlein HV. Evaluation of the Population Distribution of Dietary Contaminant Exposure in an Arctic Population Using Monte Carlo Statistics. Environmental Health Perspectives 1997;105(3):316-21.

Crystal Ball, Version 4.0. 1996. Decisioneering, Inc.

Evans M, Hastings N, and Peacock B. Statistical Distributions, 2nd Edition. 1993. John Wiley & Sons, Inc.

Heller CA and Scott EM. The Alaska Dietary Survey 1956-1961. Washington DC: US Government Printing Office, 1967. [DHEW, Public Health Service Publication No. 999-AH-2.]

Lee RC and Wright WE. Development of Human Exposure-Factor Distributions Using Maximum-Entropy Inference. Journal of Exposure Analysis and Environmental Epidemiology 1994; 4(3): 329-41.

Morgan MG and Henrion M. Uncertainty: A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis. 1990. Cambridge University Press.

Nobmann, ED. Nutrient Value of Alaska Native Foods. Alaska Area Native Health Service, Anchorage, AK Revised October 1993.

Nobmann ED, Byers T, Lanier AP, Hankin JH, Jackson MY. The diet of Alaska Native adults: 1987-1988. Am J Clin Nutr 1992;55:1024-32.

Taylor AC. Using Objective and Subjective Information to Develop Distributions for Probabilistic Exposure Assessment. Journal of Exposure Analysis and Environmental Epidemiology 1993; 3(3):285-98.

USDA Agriculture Handbook 8-5. Composition of Foods: Poultry Products. Revised August 1979.

USDA Agriculture Handbook 8-15. Composition of Foods: Finfish and Shellfish Products. Revised 1987.

USDA Agriculture Handbook 8-17. Composition of Foods: Lamb, Veal and Game Products. Revised April 1989.

Appendix A

Regional names and region codes by village according the ADFG regional classification, Ecological-Cultural regional classification and Federal regional classification

The Community Profile Database (CPDB) of the Division of Subsistence, Alaska Department of Fish & Game

Description. The Community Profile Database is a central repository of information on contemporary subsistence uses within Alaskan communities developed by the Division of Subsistence, Alaska Department of Fish and Game. Mandated by state law in 1978, the Database is designed to serve as a principal reference source for recent, reliable, summary information about the subsistence uses within the economies of rural Alaskan communities. We used the electronic version of the Database (September 1996), designed for use with ACCESS software that enabled us to conduct more complex analyses and information retrieval. This version includes information on 202 communities from 85 projects conducted between 1980-1995 by researchers in the Division of Subsistence. Information typically has been gathered in each community through detailed retrospective interviews with harvesters from a sample of households. Respondents are asked questions about their household's use of wild resources. They are typically asked to estimate the quantities of particular species harvested and used during the previous 12-month period. This includes distribution of wild resources between households. Other sources have contributed to the Database including the US Fish and Wildlife Service, Stephen R. Braund and Associates, Kawerak, Inc., the US Census Bureau, and the Alaska Department of Labor.

Rationale for selecting. We selected the Community Profile Database because it is a comprehensive source of data on harvest of subsistence resources by users in Alaska.

Strengths. The CPDB includes most of the rural communities in Alaska. Harvest data are available for major species from up to 178 communities out of 316 Census Designated Places as defined by the 1990 US Census (56%). Data were collected in the communities using consistent methodology. The format is conducive to further analyses.

Limitations. The CPDB describes amounts of resources harvested but not amounts consumed. It excludes residents of urban centers, such as Anchorage, Fairbanks and Juneau who may also harvest the resources. It does not describe which parts of the animal are consumed.

ADFG Regions

The ADFG divides the state into six regions defined by the jurisdictions of the Regional Subsistence Councils of the State Fish and Game Advisory Committee and Regional Council system. The regions are Southeast (Region 1), South Central (Region 2), Southwest (Region 3), Western (Region 4), Arctic (Region 5), and Interior (Region 6). Figure 1, below, shows boundaries of these regions. The boundaries of regions are defined based on physiographic and socio-cultural similarities. However, exact boundaries are described as arbitrary and no written description of the regions is available, according to ADFG. The regions can be described in terms of subdivisions of the region, such as the Copper River Basin, Prince William Sound, and Cook Inlet Subdivisions of the South central Region. Subdivisions are geopolitical subsets of the six regions and are grouped by similar environmental attributes of people.

A Pacific Maritime environment characterizes Region 1, Southeast, known as the Alaska Panhandle. The region extends east from beyond the mouth of the Copper River to the Canadian border. Fish, invertebrates and deer are commonly harvested. Region 2, South-central Alaska experiences colder weather but it is moderated by the ocean. It is bounded on the east by the Canadian border on the south by the Gulf of Alaska, and by lines that follow contours approximating 62° latitude south of the Alaska Range and east of 154° longitude. It includes Cook Inlet, the Copper River Basin, and Prince William Sound. Fish, invertebrates, and game animals are harvested. Region 3, Southwest Alaska, includes the Island of Kodiak, the Alaska Peninsula and the Bristol Bay drainage. The region includes tundra, mountains and volcanic activity along the Peninsula and Aleutian Islands. Major commercial fisheries are located in this region. Region 4, Western Alaska includes the Delta of Yukon-Kuskokwim Rivers. The tundra area is treeless. Fish is a major resource. Region 5 the Arctic, includes St. Lawrence Island and the land surrounding Norton Sound, Kotzebue Sound and the Arctic Ocean. It includes the Seward Peninsula, the Brooks Range, and North Slope east to the Canadian border. Sea mammals are harvested along with caribou. Region 6, Interior, includes the drainage areas of the Yukon and Kuskokwim Rivers from the Canadian border to the Y-K Delta. Salmon, moose and other game animals are harvested.

Ecological-cultural zones

The ecological cultural zones divide the state into five regions (Figure 2) defined by the ADFG Division of Subsistence. The ecological-cultural zones reflect the predominant Alaska Native culture associated with major ecological regions: Aleutian Pacific (Aleut-Alutiiq), Arctic-Subarctic Coast (Inupiat-Yupik), Southeast Alaska Coast (Tlingit-Haida), Subarctic Interior (Athabaskan) and Urban-Urban Periphery (recent major population centers). This system was selected for further analyses for several reasons. First, it may reflect coastal, interior and urban harvest patterns better than other systems. Second, ecological regions may be more justifiable from a scientific perspective than are administrative jurisdictions. Third, it was suggested by Charles J. Utermohle, Ph.D., an ADFG Research Analyst who is knowledgeable about the CPDB, that ecological cultural zones might best differentiate regions in terms of subsistence harvest.

Zone 1. The Arctic-Subarctic Coast/Yupik-Inupiaq zone includes lands bordered by Bristol Bay, Norton Sound, Kotzebue Sound and the Arctic Ocean. It extends to the Canadian border. The predominant Native cultures in the region are Inupiaq Eskimos in the northern portion of the region and Yupik Eskimos on St. Lawrence Island and in the southern portion. **Zone 2**. Aleutian Pacific/Aleut-Alutiiq Zone includes the Aleutian Chain, Kodiak Island and lands surrounding Prince William Sound, east to Icy Cape and Mt. St. Elias area. Aleuts and Alutiiqs are the predominant Native groups in this zone. **Zone 3**. Subarctic Interior/Athabascan Region includes the Yukon, Kuskokwim, and Copper River drainage areas, which extend west to but not including the Y-K Delta and east to the Canadian border. Athabascan Indians are the predominant Alaska Native group in this region. **Zone 4**. Southeast Alaska Coast/Tlingit-Haida Zone includes the islands and mainland of the Alaska Panhandle that extends south from Icy Cape and Mt.

St Elias to the Canadian border. Tlingit and Haida Indians predominate in this region. **Zone 5**. Urban/Urban-Periphery is a non-contiguous region comprised of urban communities and the areas around them. These are recent population centers that include Anchorage, Fairbanks, Juneau and Ketchikan.

Federal (US Fish and Wildlife) Subsistence Regions, as described by the USFWS, were selected for further analyses as another system for dividing the state. There are ten Federal subsistence management regions, each represented by a Federal Regional Council. Figure 3 shows the Federal subsistence regional boundaries. They are based on resource, culture and cultural use of resources. Generally, Federal subsistence regions are composed of several state of Alaska Game management. Of Alaska's 586,000 square miles, 65 percent or 380,000 square miles are Federal public lands administered by the Fish and Wildlife Service, National Park Service, Bureau of Land Management, Bureau of Indian Affairs, and Forest Service.

The **Southeast Subsistence Resource Region (Region 1)** is comprised of the southeastern panhandle, stretching 370 miles along the Canadian border. It is bounded by the Coast Mountains and contains a maze of inlets, fjords, and numerous small islands and reefs. Most of this region is in Federal ownership administered by the Tongass National Forest, Glacier Bay National Park and Preserve, and Wrangell-Saint Elias National Park and Preserve. There are 48 rural communities with a total population of about 34,000 of whom 8,000 are Alaska Natives. The regional hub of the area is Juneau, the State capital. Ketchikan and Juneau area communities have been determined to be non-rural for the purposes of administering Title VIII of ANILCA. Residents of those communities are not eligible to take fish and wildlife resources under Federal subsistence regulations. This region has a long history of a mixed cash and subsistence economy. The primary resources harvested by rural residents are salmon, Sitka black-tail deer, and bottomfish, including halibut.

The **Southcentral Subsistence Resource Region (Region 2)** is a mountainous region including the St. Elias, Chugach and Kenai Mountains and is outlined by Prince William Sound and Cook Inlet. Federal ownership in this region is more varied. Federal areas include parts of the Wrangell-Saint Elias National Park and Preserve, Kenai Fjords National Park, Lake Clark National Park and Preserve, Denali National Park and Preserve, Kenai National Wildlife Refuge, Chugach National Forest, and various BLM holdings. This region contains the majority of Alaska's population. There are 45 rural communities with a total population of about 48,000 of whom 4,000 are Alaska Natives. Alaska's largest city, Anchorage lies within this region. The communities in the Homer, Kenai, Seward, and Wasilla areas, and the Municipality of Anchorage, have been determined to be non-rural. Residents of those communities are not eligible to take fish and wildlife resources under the Federal subsistence regulations. Many of the communities are connected by roads in this region. The primary resources harvested by rural residents are salmon, caribou, and moose.

The **Kodiak/Aleutians Subsistence Resource Region (Region 3)** is composed of islands in the Kodiak and Aleutian Islands archipelago covering some 1,300 miles east to west and containing the volcanically active Aleutian Mountains. Federal lands encompass much of this region and include the Kodiak National Wildlife Refuge and the Aleutian Island Unit of the Alaska Maritime National Wildlife Refuge. Other than the Adak Naval Air Station, all communities within this region are designated as rural. Their population is about 20,000 in 20 communities including 4,000 Alaskan Natives. The regional hubs of King Salmon and Kodiak are located here. This region also has a long history of a mixed cash (from commercial fishing) and subsistence economy. The primary resources harvested by rural residents are salmon, marine mammals, deer, and marine invertebrates.

The **Bristol Bay Subsistence Resource Region (Region 4)** includes the volcanically active Alaska Peninsula and the lakes and tundra region at the head of Bristol Bay. Federal lands encompass about 40 percent of this area and include the Alaska Peninsula/Becharof National Wildlife Refuge, Izembek National Wildlife Refuge, Togiak National Wildlife Refuge, Katmai National Park and Preserve, Lake Clark National Park and Preserve, Aniakchak National Monument and Preserve, and scattered BLM lands. There are no non-rural areas within the region. There are 30 communities with a total population of about 7,000 of whom about 4,000 are Alaskan Natives. Dillingham serves as the regional hub community. Most residents are heavily involved in the commercial fishing industry. The primary resources harvested by rural residents are salmon, caribou, marine mammals, and moose.

The **Yukon-Kuskokwim Delta Subsistence Resource Region (Region 5)** contains the two largest rivers in Alaska - the Yukon and the Kuskokwim - flowing from the interior into the Bering Sea. Both rivers carry sediment from far inland and have established huge low-lying deltas. The Yukon-Kuskokwim Delta combined is over 200 miles wide and one of the largest in North America. Most of the region is Federal land administered by the Yukon Delta National Wildlife Refuge. Thirty-nine communities have a population of about 18,000 which includes 16,000 Alaskan Natives. There are no non-rural communities in the region. Bethel is the largest community and a regional hub. Many of the smaller, more remote villages practice a traditional subsistence lifestyle. The primary resources harvested by residents are salmon, waterfowl, and freshwater fish.

The **Western Interior Subsistence Resource Region (Region 6)** is characterized by a broad expanse of plateaus and lowlands drained by the Yukon and Kuskokwim Rivers. About 30-40 percent of this region is Federally-owned. Federal areas within the region are administered by the Innoko National Wildlife Refuge, Koyukuk/Nowitna National Wildlife Refuge, Kanuti National Wildlife Refuge, scattered BLM lands, Lake Clark National Park and Preserve, Denali National Park and Preserve, and Gates of the Arctic National Park National Park and Preserve. There are 27 communities with a population of about 6,000 that includes approximately 4,000 Alaskan Natives. The region's hub communities are McGrath and Galena. The entire region has been determined to be rural. The primary resources harvested by residents of the region are moose, caribou, brown bear, black bear, Dall sheep, fish, waterfowl, and small game.

The **Seward Peninsula Subsistence Resource Region (Region 7)** is an area of many small streams and rolling hills bounded on the west by the Bering and Chukchi Seas and inland by the Nulato Hills. Much of the BLM land in this region has been selected by the State, but portions of the Yukon Delta National Wildlife Refuge and Bering Land Bridge National Preserve also fall within the region. There are seventeen communities with a population of 8,000 that includes 6,000 Alaskan Natives. There are no non-rural communities in the region. People in this area are particularly dependent on domestic reindeer herds. Other primary resources harvested by residents of the region are marine mammals, caribou, moose, brown bear, salmon, and freshwater fishes. A wide range of resources are used by individuals and shared extensively in a network of trade and kinship.

The **Northwest Arctic Subsistence Resource Region (Region 8)**, an area drained by the Noatak and Kobuk Rivers, is a mixture of lowlands, tundra and hills facing the Chukchi sea to the west. This region has a number of mineral features including the Red Dog zinc mine. Approximately 75 percent of the region is in Federal ownership with extensive blocks of BLM lands, the Selawik National Wildlife Refuge, Kobuk Valley National Park, Noatak National Preserve, Cape Krusenstern National Monument, and part of the Bering Land Bridge National Preserve. There are only 11 communities in this region with a total population of about 6,000 of whom 5,000 are Alaskan Natives. Kotzebue is the largest and the regional hub community. All areas of the region are designated as rural. The primary resources harvested by residents are marine mammals, caribou, moose, brown bear, salmon, and freshwater fishes. A wide range of resources are used by individuals and shared extensively in a network of trade and kinship.

The **Eastern Interior Subsistence Resource Region (Region 9)** is characterized by a broad expanse of plateaus and lowlands drained by the Yukon and Kuskokwim Rivers. About 30-40 percent of this region is Federally owned. Federal areas within the region include the Tetlin National Wildlife Refuge, Yukon Flats National Wildlife Refuge, Arctic National Wildlife Refuge, Denali National Park and Preserve, Wrangell-Saint Elias National Park and Preserve, Steese National Conservation Area, White Mountains National Recreation Area, and scattered blocks of other BLM lands. There are 35 communities in this region with a total population of about 10,000 including 3,000 Alaskan Natives. Many communities are connected by roads. The hub of this region is Fairbanks, the second largest community in the State. The Fairbanks-North Star Borough is designated as non-rural. Residents of the Borough are not eligible to take fish and wildlife under Federal subsistence regulations. The primary resources harvested by rural residents are moose, caribou, brown bear, black bear, Dall sheep, fish, waterfowl, and small game.

The **North Slope Subsistence Resource Region (Region 10)** is a fairly uniform, wide coastal plain intersected by the sea with low cliffs and numerous lagoons and spits. Famous for its producing oil deposits, the region stretches from the Canadian border all the way across the northern part of Alaska and rises from sea level to the Brooks Range and Continental Divide. About 60 percent of the region is in Federal ownership administered by the Arctic National Wildlife Refuge, National Petroleum Reserve-Alaska, and Gates of the Arctic National Park and Preserve. There are only 10 communities in the region. Barrow is the regional hub. All areas are designated as rural.

The total population is about 6,000 including 4,000 Alaskan Natives. The primary resources harvested by residents are marine mammals (Beluga, bowhead, and gray whale, polar bear, seals, and walrus), caribou, Dall sheep, migratory birds, and fish.

Table 14: Regional names and region codes according the ADFG regional classification, Ecological-Cultural regional classification and Federal regional classification.

ADFG Regions	Region Codes
Southeast	1
Southcentral	2
Southwest	3
Western	4
Arctic	5
Interior	6

Ecological-Cultural Regions	Region Codes
Arctic-Subarctic Coast/Yupik-Inupiaq	1
Aleutian Pacific/Aleut-Alutiiq	2
Subarctic Interior/Athabaskan	3
Southeast Alaska Coast/Tlingit-Haida	4
Urban-Urban Periphery	5

Federal Regions	Region Codes
Southeast	1
Southcentral	2
Kodiak/Aleutians	3
Bristol Bay	4
Yukon/Kuskokwim Delta	5
Western Interior	6
Seward Peninsula	7
Northwest Arctic	8
Eastern Interior	9
North Slope	10

Figure 1: ADFG Subsistence Region Boundary Map

Figure 2: Ecological-Cultural Subsistence Region Boundary Map

Figure 3: Federal Subsistence Region Boundary Map

Table 15: Community name and associated region codes

Community Name	ADFG Code	Eco-Cultural Code	Federal Code
Akhiok	3	2	3
Akutan	3	2	3
Alakanuk	4	1	5
Aleknagik	3	1	4
Allakaket/Alatna	6	3	6
Anaktuvuk Pass	5	1	6
Anderson	6	3	9
Angoon	1	4	1
Atka	3	2	3
Barrow	5	1	10
Beaver	6	3	9
Beecher Pass	1	4	1
Bettles/Evansville	6	3	6
Brevig Mission	5	1	7
Cantwell	2	3	2
Chase	2	5	2
Chenega Bay	2	2	2
Chickaloon	2	3	2
Chignik Bay	3	2	4
Chignik Lagoon	3	2	4
Chignik Lake	3	2	4
Chiniak	3	2	3
Chisana	6	3	2
Chistochina	2	3	2
Chitina	2	3	2
Chuathbaluk	4	1	6
Clark's Point	3	1	4
Coffman Cove	1	4	1
Cooper Landing	2	5	2
Copper Center	2	3	2
Cordova	2	2	2
Craig	1	4	1
Deering	5	1	8
Dillingham	3	1	4
Diomede	5	1	7
Dot Lake	6	3	9
East Glenn Highway	2	3	2
Edna Bay	1	4	1
Egegik	3	1	4
Ekwok	3	1	4
Elfin Cove	1	4	1
Elim	5	1	7
Emmonak	4	1	5

Community Name	ADFG Code	Eco-Cultural Code	Federal Code
False Pass	3	2	3
Fort Yukon	6	3	9
Gakona	2	3	2
Galena	6	3	6
Glennallen	2	3	2
Gold Creek	2	5	2
Golovin	5	1	7
Gulkana	2	3	2
Gustavus	1	4	1
Haines	1	4	1
Healy	6	3	9
Hollis	1	4	1
Homer	2	5	2
Hoonah	1	4	1
Hope	2	5	2
Hughes	6	3	6
Hurricane-Broad Pass	2	5	2
Huslia	6	3	6
Hydaburg	1	4	1
Hyder	1	4	1
Igiugig	3	1	4
Iliamna	3	1	4
Ivanof Bay	3	2	4
Kake	1	4	1
Kaktovik	5	1	10
Kaltag	6	3	6
Karluk	3	2	3
Kasaan	1	4	1
Kenai	2	5	2
Kenny Lake	2	3	2
Kiana	5	1	8
King Cove	3	2	3
King Salmon	3	1	4
Kipnuk	4	1	5
Kivalina	5	1	8
Klawock	1	4	1
Klukwan	1	4	1
Kodiak City	3	2	3
Kodiak Coast Guard Station	3	2	3
Kodiak Road	3	2	3
Kokhanok	3	1	4
Koliganek	3	1	4
Kotlik	4	1	5

Community Name	ADFG Code	Eco-Cultural Code	Federal Code
Kotzebue	5	1	8
Koyuk	5	1	7
Kwethluk	4	1	5
Lake Louise	2	3	2
Larsen Bay	3	2	3
Levelock	3	1	4
Lower Tonsina	2	3	2
Manokotak	3	1	4
Matanuska Glacier	2	3	2
McCarthy Road	2	3	2
McGrath	6	3	6
McKinley Park Village	6	3	9
Mekoryuk	4	1	5
Mentasta	2	3	2
Mentasta Pass	2	3	2
Metlakatla	1	4	1
Meyers Chuck	1	4	1
Minto	6	3	9
Mountain Village	4	1	5
Nabesna Road	2	3	9
Naknek	3	1	4
Nanwalek	2	2	2
Nelson Lagoon	3	2	3
New Stuyahok	3	1	4
Newhalen	3	1	4
Newtok	4	1	5
Nightmute	4	1	5
Nikolai	6	3	6
Nikolski	3	2	3
Ninilchik	2	5	2
Noatak	5	1	8
Nome	5	1	7
Nondalton	3	3	4
North Wrangell Mountains	6	3	9
Northway	6	3	9
Nuiqsut	5	1	10
Nunapitchuk	4	1	5
Old Harbor	3	2	3
Ouzinkie	3	2	3
Parks Highway South	2	5	2
Paxson	2	3	2
Paxson-Sourdough	2	3	2
Pedro Bay	3	3	4

Community Name	ADFG Code	Eco-Cultural Code	Federal Code
Pelican	1	4	1
Perryville	3	2	4
Petersburg	1	4	1
Petersville Road	2	5	2
Pilot Point	3	1	4
Pilot Point/Ugashik	3	1	4
Point Baker	1	4	1
Point Lay	5	1	10
Port Alexander	1	4	1
Port Alsworth	3	3	4
Port Graham	2	2	2
Port Heiden	3	1	4
Port Lions	3	2	3
Port Protection	1	4	1
Quinhagak	4	1	5
Russian Mission	4	1	5
Saint George	3	1	3
Saint Paul	3	1	3
San Juan Bay	2	2	2
Sand Point	3	2	3
Saxman	1	5	1
Selawik	5	1	8
Seldovia	2	2	2
Shaktoolik	5	1	7
Sheep Mountain	2	3	2
Sheldon Point	4	1	5
Shishmaref	5	1	7
Shungnak	5	1	8
Sitka	1	4	1
Skagway	1	4	1
Slana	2	3	2
Slana Homestead North	2	3	2
Slana Homestead South	2	3	2
Sleetmute	4	1	6
Sourdough	2	3	2
South Naknek	3	1	4
South Wrangell Mountains	2	3	2
Stebbins	5	1	7
Stevens Village	6	3	9
Talkeetna	2	5	2
Tanacross	6	3	9
Tanana	6	3	9

Community Name	ADFG Code	Eco-Cultural Code	Federal Code
Tatitlek	2	2	2
Tazlina	2	3	2
Teller	5	1	7
Tenakee Springs	1	4	1
Tetlin	6	3	9
Thorne Bay	1	4	1
Togiak	3	1	4
Tok	6	3	9
Toksook Bay	4	1	5
Tonsina	2	3	2
Trapper Creek	2	5	2
Tuluksak	4	1	5
Tununak	4	1	5
Tyonek	2	3	2
Ugashik	3	1	4
Unalakleet	5	1	7
Unalaska	3	2	3
Valdez	2	2	2
Wainwright	5	1	10
Wales	5	1	7
West Glenn Highway	2	3	2
Whale Pass	1	4	1
White Mountain	5	1	7
Whittier	2	5	2
Wrangell	1	4	1
Yakutat	1	4	1

Appendix B

Definitions

Definitions

Birds and eggs. Includes migratory birds such as ducks, geese, seabirds and loons; other birds such as grouse, ptarmigan, and upland game birds; and eggs such as seabird and loon eggs.

Ecological-Cultural Zone. This attribute identifies the community's location in relation to five ecological-cultural zones defined by the Division of Subsistence. The ecological-cultural zones reflect the predominant Alaska Native culture associated with major ecological regions: Aleutian Pacific (Aleut-Alutiiq), Arctic-Subarctic Coast (Inupiat-Yupik), Southeast Alaska Coast (Tlingit-Haida), Subarctic Interior (Athabaskan) and Urban-Urban Periphery (recent major population centers).

Edible pounds. A measure of the portion of the kill brought into a household's kitchen for use, representing the usable pounds of the wild resources harvested (sometimes referred to as "usable weight" or "dressed weight"). In general, "edible pounds" is about 70-75 % of round weight for fish or birds, 60-65% of round weight for game, and 20-60% of round weight for marine mammals, and it includes bones for particular species. It is equivalent to the weights of domestic meat, fish, and poultry when purchased in a store.

Federal Subsistence Region. This attribute identifies the community's location in relation to the ten Federal subsistence management regions, each represented by a Federal Regional Council.

Feral animals. Includes bison, sheep, reindeer, cattle, and rabbits.

Fish eggs (roe). Includes herring spawn on kelp.

Fish. Includes salmon and non-salmon.

Land Mammals. Includes large land mammals such as black bear, deer, goat, moose; small land mammals/furbearers which are not eaten in some communities, and feral animals.

Marine invertebrates. Includes abalone, chitons, clams, crabs, octopus, scallops, sea cucumber, sea urchin, shrimp, and unknown marine invertebrates.

Marine mammals. Includes seal, harbor seal, sea otters, sea lions, polar bear, and unidentified.

Non-salmon. Includes herring, smelt, cod, flounder, halibut, rockfish, char, and unidentified non-salmon fish.

Region. This attribute identifies the community's location in relation to six regions defined by the jurisdictions of the Regional Subsistence Councils of the State Fish and Game Advisory Committee and Regional Council system: Southeast (Region 1), South central (Region 2), Southwest (Region 3), Western (Region 4), Arctic (Region 5), and Interior (Region 6).

Salmon. Includes Chum (or Dog salmon), Coho (or Silver), Chinook (or King), Pink (or Humpy) and Sockeye (or Red salmon).

Vegetation. Includes berries, plants/greens/mushrooms, seaweed/kelp, and wood.

Appendix C

Average per capita harvest of major resource categories by each of three regional classification schemes

Table 16: Ecological-Cultural Per Capita Harvest Rates by Sub-Region

Eco-Cult Region	Resource	Per Capita Harvest	Minimum Per Capita Harvest	Maximum Per Capita Harvest
Arctic-Subarctic	Salmon	143.19	0.28	671.61
	Non-Salmon Fish	118.04	11.70	667.99
	Large Land Mammals	100.26	0.00	408.00
	Small Land Mammals	9.59	0.00	57.50
	Feral Animals	4.62	1.94	8.59
	Marine Mammals	124.16	0.00	637.41
	Migratory Birds	9.63	0.00	44.78
	Other Birds	1.72	0.00	9.57
	Bird Eggs	0.62	0.00	7.98
	Marine Invertebrates	1.87	0.00	23.27
	Vegetation	11.12	0.00	44.19
Aleutian Pacific	Salmon	65.87	32.64	319.70
	Non-Salmon Fish	52.96	8.17	222.56
	Large Land Mammals	25.39	0.00	154.51
	Small Land Mammals	0.60	0.00	1.88
	Feral Animals	2.11	0.00	199.71
	Marine Mammals	6.55	0.57	153.77
	Migratory Birds	1.18	0.00	20.68
	Other Birds	0.48	0.02	8.82
	Bird Eggs	0.24	0.00	6.35
	Marine Invertebrates	14.00	4.18	45.28
	Vegetation	5.81	2.08	12.76
Subarctic Interior	Salmon	236.06	0.00	1600.01
	Non-Salmon Fish	51.12	3.70	358.43
	Large Land Mammals	84.92	23.71	378.63
	Small Land Mammals	9.76	0.08	57.23
	Marine Mammals	1.01	0.00	2.56
	Migratory Birds	5.68	0.00	44.61
	Other Birds	1.94	0.28	7.67
	Bird Eggs	0.02	0.00	1.04
	Marine Invertebrates	0.65	0.00	4.51
	Vegetation	5.39	1.82	24.39
SE AK Coast	Salmon	46.75	17.67	174.28
	Non-Salmon Fish	46.84	16.02	175.03
	Large Land Mammals	43.38	3.99	190.61
	Small Land Mammals	0.10	0.00	1.30
	Marine Mammals	4.91	0.00	36.71
	Migratory Birds	2.00	0.00	37.90
	Other Birds	0.15	0.00	1.18
	Bird Eggs	0.02	0.00	0.34
	Marine Invertebrates	25.47	0.87	116.49
	Vegetation	6.25	1.50	23.59
Urban	Salmon	25.85	18.17	66.47
	Non-Salmon Fish	22.29	2.50	30.11
	Large Land Mammals	18.32	10.50	118.07
	Small Land Mammals	0.45	0.00	5.78
	Feral Animals	0.11	0.11	0.11
	Marine Mammals	0.12	0.00	2.35
	Migratory Birds	0.66	0.00	2.16
	Other Birds	0.68	0.00	5.58
	Bird Eggs	0.00	0.00	0.04
	Marine Invertebrates	9.71	0.00	16.77
	Vegetation	2.46	1.76	18.56

Table 17: ADFG Per Capita Harvest Rates by Sub-Region

ADFG Region	Resource	Per Capita Harvest	Minimum Per Capita Harvest	Maximum Per Capita Harvest
Southeast	Salmon	46.61	17.67	174.28
	Non-Salmon Fish	46.55	16.02	175.03
	Large Land Mammals	43.16	3.99	190.61
	Small Land Mammals	0.10	0.00	1.30
	Marine Mammals	4.89	0.00	36.71
	Migratory Birds	1.99	0.00	37.90
	Other Birds	0.15	0.00	1.18
	Bird Eggs	0.02	0.00	0.34
	Marine Invertebrates	25.30	0.87	116.49
	Vegetation	6.22	1.50	23.59
Southcentral	Salmon	37.75	7.10	186.63
	Non-Salmon Fish	25.32	2.50	141.18
	Large Land Mammals	26.05	3.13	139.06
	Small Land Mammals	1.03	0.00	36.21
	Feral Animals	0.11	0.00	0.14
	Marine Mammals	0.98	0.00	61.24
	Migratory Birds	0.73	0.00	10.47
	Other Birds	0.75	0.02	7.67
	Bird Eggs	0.05	0.00	1.38
	Marine Invertebrates	7.75	0.00	21.03
	Vegetation	3.57	1.76	18.56
Southwest	Salmon	107.81	3.06	720.99
	Non-Salmon Fish	55.20	8.17	222.56
	Large Land Mammals	44.79	0.00	408.00
	Small Land Mammals	4.04	0.00	57.50
	Feral Animals	3.31	0.00	199.71
	Marine Mammals	12.10	0.00	153.77
	Migratory Birds	1.87	0.00	20.68
	Other Birds	0.95	0.00	9.57
	Bird Eggs	0.36	0.00	6.35
	Marine Invertebrates	12.64	0.00	45.28
	Vegetation	7.68	0.00	28.09
Western	Salmon	272.50	114.64	671.61
	Non-Salmon Fish	306.86	149.50	667.99
	Large Land Mammals	53.88	18.72	149.95
	Small Land Mammals	24.81	1.94	51.22
	Marine Mammals	88.60	7.97	221.85
	Migratory Birds	26.90	12.98	44.78
	Other Birds	5.65	3.90	7.50
	Bird Eggs	0.54	0.32	0.86
	Marine Invertebrates	5.07	5.07	5.07
	Vegetation	27.20	4.48	44.19
Arctic	Salmon	56.52	0.28	389.41
	Non-Salmon Fish	86.88	20.82	229.26
	Large Land Mammals	121.79	9.41	300.25
	Small Land Mammals	0.87	0.00	7.66
	Feral Animals			
	Marine Mammals	200.96	47.67	637.41
	Migratory Birds	8.17	3.20	44.18
	Other Birds	1.07	0.00	4.55
	Bird Eggs	0.66	0.00	7.98
	Marine Invertebrates	1.70	0.07	23.27
	Vegetation	7.66	0.19	33.81
Interior	Salmon	334.24	0.00	1600.01
	Non-Salmon Fish	74.55	6.75	358.43
	Large Land Mammals	104.95	28.87	378.63
	Small Land Mammals	13.33	0.86	57.23
	Migratory Birds	9.20	0.23	44.61
	Other Birds	2.40	0.28	5.72
	Bird Eggs	0.01	0.00	0.03
	Marine Invertebrates	0.79	0.00	3.60
	Vegetation	4.47	1.82	24.39

Table 18: Federal Per Capita Harvest Rates by Sub-Region

Federal Region	Resource	Per Capita Harvest	Minimum Per Capita Harvest	Maximum Per Capita Harvest
Southeast	Salmon	46.61	17.67	174.28
	Non-Salmon Fish	46.55	16.02	175.03
	Large Land Mammals	43.16	3.99	190.61
	Small Land Mammals	0.10	0.00	1.30
	Marine Mammals	4.89	0.00	36.71
	Migratory Birds	1.99	0.00	37.90
	Other Birds	0.15	0.00	1.18
	Bird Eggs	0.02	0.00	0.34
	Marine Invertebrates	25.30	0.87	116.49
	Vegetation	6.22	1.50	23.59
Southcentral	Salmon	37.66	3.54	186.63
	Non-Salmon Fish	25.29	2.50	141.18
	Large Land Mammals	25.93	3.13	139.06
	Small Land Mammals	1.02	0.00	36.21
	Feral Animals	0.11	0.00	0.14
	Marine Mammals	0.98	0.00	61.24
	Migratory Birds	0.73	0.00	10.47
	Other Birds	0.75	0.02	7.67
	Bird Eggs	0.05	0.00	1.38
	Marine Invertebrates	7.76	0.00	21.03
	Vegetation	3.57	1.76	18.56
Kodiak-Aleutians	Salmon	66.92	3.06	319.70
	Non-Salmon Fish	61.58	8.17	222.56
	Large Land Mammals	22.06	0.00	130.00
	Small Land Mammals	0.61	0.00	1.88
	Feral Animals	3.31	0.00	199.71
	Marine Mammals	14.10	1.17	153.77
	Migratory Birds	1.25	0.00	20.68
	Other Birds	0.38	0.02	8.82
	Bird Eggs	0.26	0.02	6.35
	Marine Invertebrates	16.02	1.08	45.28
	Vegetation	6.23	2.08	12.76
Bristol Bay	Salmon	225.47	85.11	720.99
	Non-Salmon Fish	36.85	11.60	101.96
	Large Land Mammals	110.20	17.98	408.00
	Small Land Mammals	13.93	0.24	57.50
	Marine Mammals	7.99	0.00	135.91
	Migratory Birds	3.62	0.00	17.40
	Other Birds	2.60	0.00	9.57
	Bird Eggs	0.64	0.00	3.70
	Marine Invertebrates	3.05	0.00	35.71
	Vegetation	12.43	0.00	28.09
Yukon-Kuskok.	Salmon	263.66	114.64	671.61
	Non-Salmon Fish	306.86	149.50	667.99
	Large Land Mammals	49.93	18.72	103.45
	Small Land Mammals	24.62	1.94	51.22
	Marine Mammals	88.60	7.97	221.85
	Migratory Birds	26.90	12.98	44.78
	Other Birds	5.65	3.90	7.50
	Bird Eggs	0.54	0.32	0.86
	Marine Invertebrates	5.07	5.07	5.07
	Vegetation	27.20	4.48	44.19

Table 18: Federal Per Capita Harvest Rates by Sub-Region cont.

Federal Region	Resource	Per Capita Harvest	Minimum Per Capita Harvest	Maximum Per Capita Harvest
Western Interior	Salmon	436.14	37.84	1162.29
	Non-Salmon Fish	55.83	6.75	142.84
	Large Land Mammals	157.00	75.79	378.63
	Small Land Mammals	13.27	1.49	41.17
	Migratory Birds	11.95	1.74	32.16
	Other Birds	1.27	0.28	2.17
	Vegetation	4.85	2.02	24.39
Seward Pen.	Salmon	167.17	19.02	389.41
	Non-Salmon Fish	106.01	20.82	229.26
	Large Land Mammals	59.50	9.41	116.35
	Small Land Mammals	3.48	0.22	7.66
	Feral Animals			
	Marine Mammals	397.88	219.56	580.33
	Migratory Birds	9.17	3.30	39.82
	Other Birds	1.26	0.00	4.55
	Bird Eggs	0.94	0.10	7.98
	Marine Invertebrates	8.49	1.41	23.27
	Vegetation	20.86	4.69	33.81
NW Arctic	Salmon	78.53	6.46	183.10
	Non-Salmon Fish	126.74	45.30	223.68
	Large Land Mammals	167.39	149.24	300.25
	Small Land Mammals	0.83	0.00	1.15
	Marine Mammals	151.48	47.67	452.87
	Migratory Birds	4.97	3.20	19.77
	Other Birds	1.09	0.43	2.37
	Bird Eggs	0.31	0.00	1.47
	Marine Invertebrates	0.16	0.07	0.18
	Vegetation	11.51	4.85	12.63
Eastern Interior	Salmon	287.59	0.00	1600.01
	Non-Salmon Fish	81.76	11.28	358.43
	Large Land Mammals	82.86	28.87	199.74
	Small Land Mammals	14.05	0.86	57.23
	Migratory Birds	8.07	0.00	44.61
	Other Birds	2.84	0.64	5.72
	Bird Eggs	0.01	0.00	0.03
	Marine Invertebrates	0.79	0.00	3.60
	Vegetation	4.34	1.82	15.23
North Slope	Salmon	1.63	0.28	3.52
	Non-Salmon Fish	43.65	21.22	208.31
	Large Land Mammals	98.26	70.23	203.33
	Small Land Mammals	0.10	0.00	0.97
	Marine Mammals	186.52	128.04	637.41
	Migratory Birds	10.43	7.87	44.18
	Other Birds	0.73	0.24	3.22
	Bird Eggs	0.37	0.02	1.48
	Vegetation	0.32	0.19	1.85

Appendix D

Average per capita harvest of five major resource categories by each of three regional classification schemes

Table 19: Per Capita Harvest Rates of Five Most Harvested Resources by Ecological -Cultural Sub-Region

Eco-Cultural Region	The Five Most Harvested Resources (population weighted per capita lbs.)					Total Per Capita Resources Harvested
Arctic-Subarctic Coast	Salmon 143.19	Marine Mammals 124.16	Non-Salmon Fish 118.04	Large Land Mammals 100.26	Vegetation 11.12	542.82
Aleutian Pacific	Salmon 65.87	Non-Salmon Fish 52.96	Large Land Mammals 25.39	Marine Invertebrates 14.00	Marine Mammals 6.55	175.18
Subarctic Interior	Salmon 236.06	Large Land Mammals 84.92	Non-Salmon Fish 51.12	Small Land Animals 9.76	Migratory Birds 5.68	396.56
Southeast Alaska Coast	Non-Salmon Fish 46.84	Salmon 46.75	Large Land Mammals 43.37	Marine Invertebrates 25.47	Vegetation 6.25	175.86
Urban; Urban Periphery	Salmon 25.84	Non-Salmon Fish 22.29	Large Land Mammals 18.32	Marine Invertebrates 9.71	Vegetation 2.46	80.64

Table 20: Per Capita Harvest Rates of Five Most Harvested Resources by ADFG Sub-Region

ADFG Region	The Five Most Harvested Resources (population weighted per capita lbs.)					Total Per Capita Resources Harvested
Southeast	Salmon 46.61	Non-Salmon Fish 46.55	Large Land Mammals 43.16	Marine Invertebrates 25.30	Vegetation 6.22	174.98
Southcentral	Salmon 37.75	Large Land Mammals 26.05	Non-Salmon Fish 25.32	Marine Invertebrates 7.75	Vegetation 3.57	104.08
Southwest	Salmon 107.81	Non-Salmon Fish 55.20	Large Land Mammals 44.79	Marine Invertebrates 12.64	Marine Mammals 12.10	250.75
Western	Non-Salmon Fish 306.86	Salmon 272.50	Marine Mammals 88.60	Large Land Mammals 53.88	Vegetation 27.20	812.02
Arctic	Marine Mammals 200.96	Large Land Mammals 121.79	Non-Salmon Fish 86.88	Salmon 56.52	Migratory Birds 8.17	486.29
Interior	Salmon 334.24	Large Land Mammals 104.95	Non-Salmon Fish 74.55	Small Land Mammals 13.33	Migratory Birds 9.20	543.94

Table 21: Per Capita Harvest Rates of Five Most Harvested Resources by Federal Sub-Region

Fed Region	The Five Most Harvested Resources (population weighted per capita lbs.)					Total Per Capita Resources Harvested
Southeast	Salmon 46.61	Non-Salmon Fish 46.55	Large Land Mammals 43.16	Marine Invertebrates 25.30	Vegetation 6.22	174.98
Southcentral	Salmon 37.66	Large Land Mammals 25.94	Non-Salmon Fish 25.29	Marine Invertebrates 7.76	Vegetation 3.57	103.85
Kodiak-Aleutians	Salmon 66.92	Non-Salmon Fish 61.58	Large Land Mammals 22.06	Marine Invertebrate 16.02	Marine Mammals 14.10	192.71
Bristol Bay	Salmon 225.47	Large Land Mammals 110.20	Non-Salmon Fish 36.85	Small Land Mammals 13.93	Vegetation 12.43	416.78
Yukon-Kuskokwim	Non-Salmon Fish 306.86	Salmon 263.66	Marine Mammals 88.60	Large Land Mammals 49.93	Vegetation 27.20	799.04
Western Interior	Salmon 436.14	Large Land Mammals 156.00	Non-Salmon Fish 55.83	Small Land Mammals 13.27	Migratory Birds 11.95	680.30
Seward Peninsula	Marine Mammals 397.88	Salmon 167.17	Non-Salmon Fish 106.01	Large Land Mammals 59.50	Vegetation 20.86	774.74
Northwest Arctic	Large Land Mammals 167.39	Marine Mammals 151.48	Non-Salmon Fish 126.74	Salmon 78.53	Vegetation 11.51	543.00
Eastern Interior	Salmon 287.59	Large Land Mammals 82.86	Non-Salmon Fish 81.76	Small Land Mammals 14.05	Migratory Birds 8.07	482.30
North Slope	Marine Mammals 186.52	Large Land Mammals 98.26	Non-Salmon Fish 43.65	Migratory Birds 10.43	Salmon 1.63	342.01

Appendix E

Subsistence resource ranks by average per capita for each of three regional classification schemes

Table 22: Significance of Resources as Related to Per Capita Harvest - All Regional Classifications

Resource	Number of Times Ranked First	Number of Times Ranked Second	Number of Times Ranked Third	Number of Times Ranked Fourth	Total Number of Times Ranked in Top Four
Salmon	14	4	0	2	20
Non-Salmon Fish	3	6	12	0	21
Large Land Mammals	1	9	7	4	21
Small Land Mammals	0	0	0	5	5
Marine Mammals	3	2	2	0	7
Migratory Birds	0	0	0	1	1
Marine Invertebrates	0	0	0	9	9

Table 23: Significance of Resources as Related to Per Capita Harvest - Eco-Cultural Regions

Resource	Number of Times Ranked First	Number of Times Ranked Second	Number of Times Ranked Third	Number of Times Ranked Fourth	Total Number of Times Ranked in Top Four
Salmon	4	1	0	0	5
Non-Salmon Fish	1	2	2	0	5
Large Land Mammals	0	1	3	1	5
Small Land Mammals	0	0	0	1	1
Marine Mammals	0	1	0	0	1
Migratory Birds	0	0	0	0	0
Marine Invertebrates	0	0	0	3	3

Table 24: Significance of Resources as Related to Per Capita Harvest - ADFG Regions

Resource	Number of Times Ranked First	Number of Times Ranked Second	Number of Times Ranked Third	Number of Times Ranked Fourth	Total Number of Times Ranked in Top Four
Salmon	4	1	0	1	6
Non-Salmon Fish	1	2	3	0	6
Large Land Mammals	0	3	2	1	6
Small Land Mammals	0	0	0	1	1
Marine Mammals	1	0	1	0	2
Migratory Birds	0	0	0	0	0
Marine Invertebrates	0	0	0	3	3

Table 25: Significance of Resources as Related to Per Capita Harvest - Federal Regions

Resource	Number of Times Ranked First	Number of Times Ranked Second	Number of Times Ranked Third	Number of Times Ranked Fourth	Total Number of Times Ranked in Top Four
Salmon	6	2	0	1	9
Non-Salmon Fish	1	2	7	0	10
Large Land Mammals	1	5	2	2	10
Small Land Mammals	0	0	0	3	3
Marine Mammals	2	1	1	0	4
Migratory Birds	0	0	0	1	1
Marine Invertebrates	0	0	0	3	3

Appendix F

Average per capita harvest histograms for all resource categories by each of three regional classification schemes

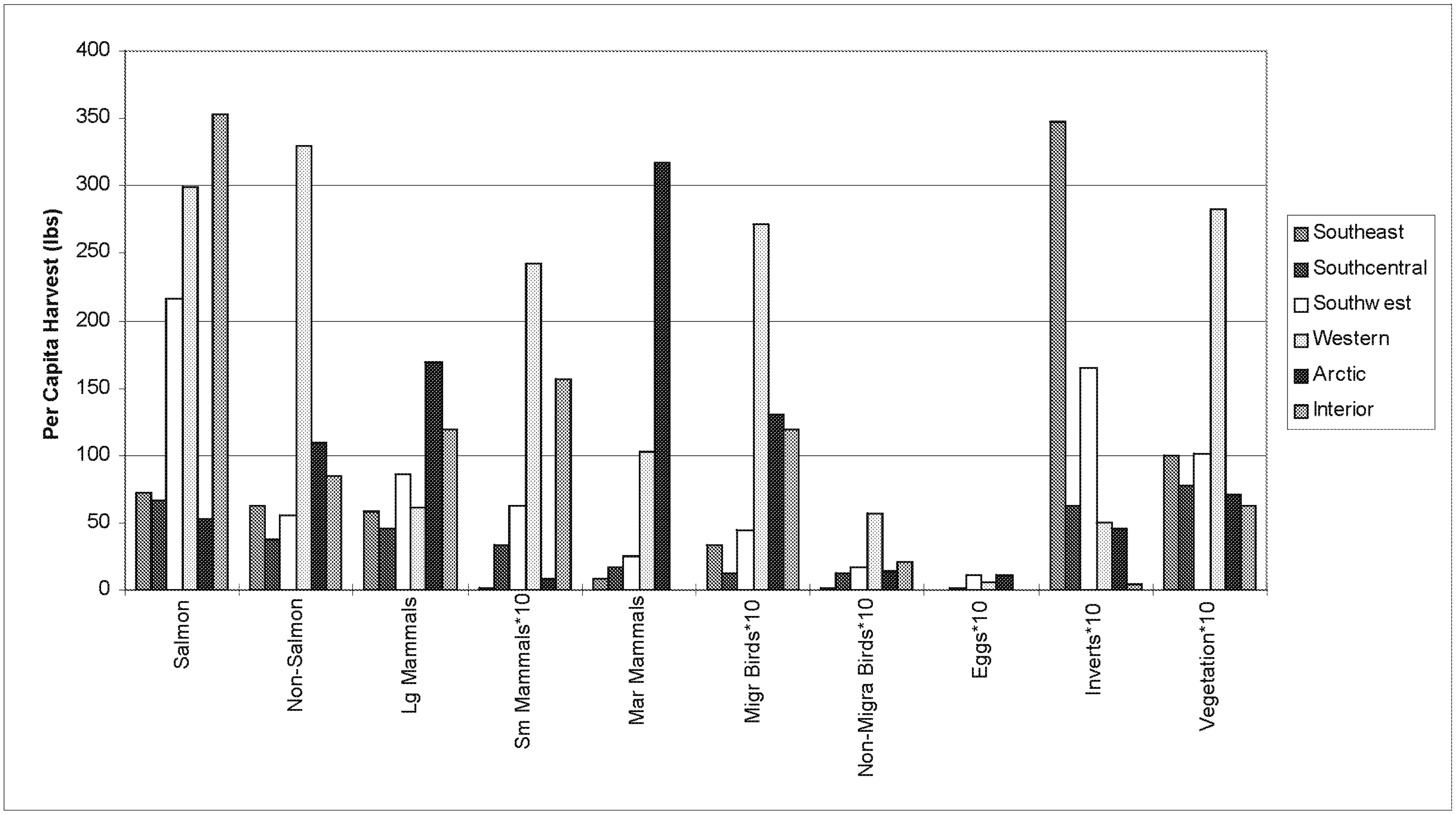


Figure 4: Per Capita Harvest Rates by Species for each ADFG Sub-region. Note that per capita harvest rates for some species have been multiplied by 10 in order to examine regional differences on the scale presented.

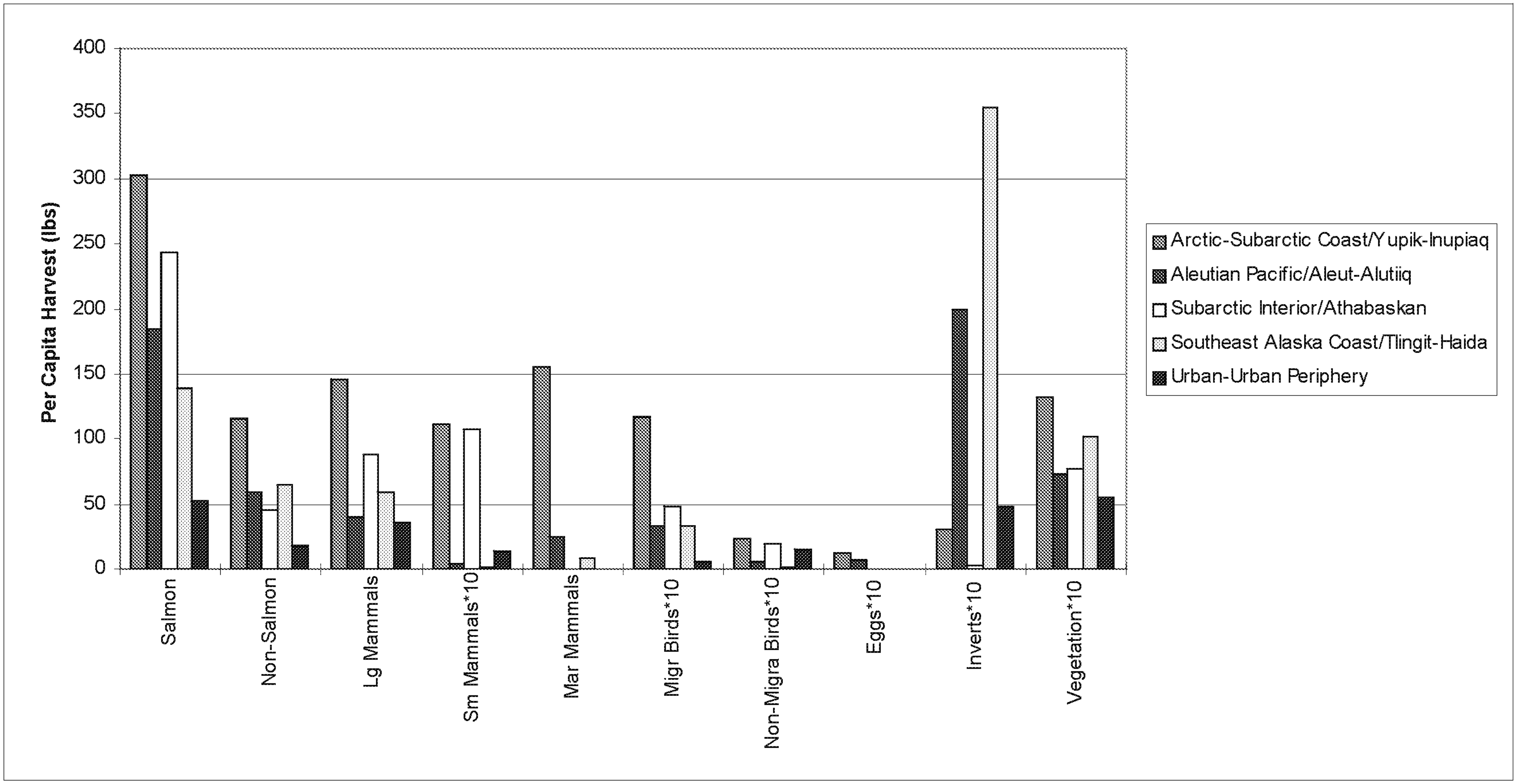


Figure 5: Per Capita Harvest Rates by Species for each Ecological-Cultural Sub-region. Note that per capita harvest rates for some species have been multiplied by 10 in order to examine regional differences on the scale presented.

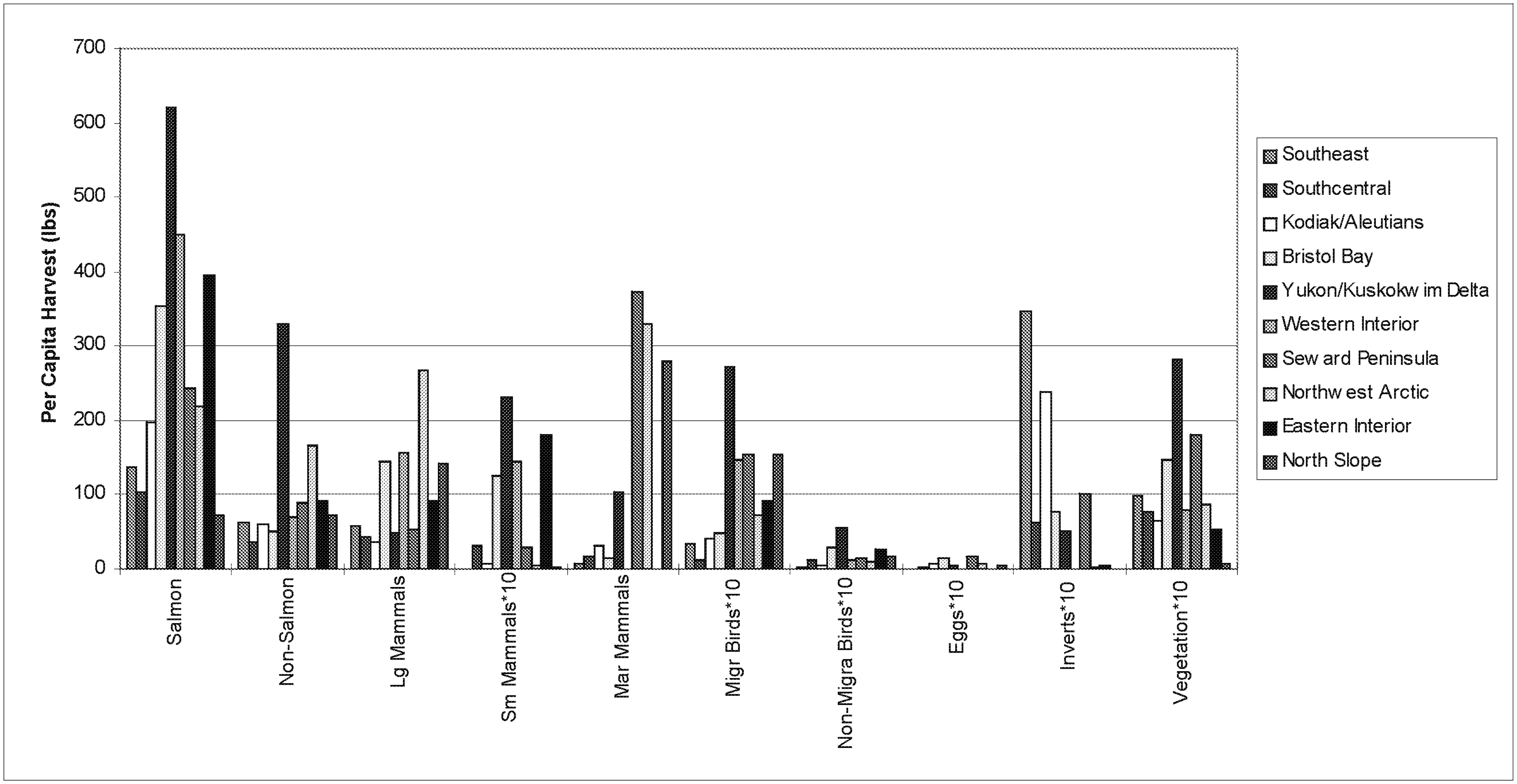


Figure 6: Per Capita Harvest Rates by Species for each Federal Sub-region. Note that per capita harvest rates for some species have been multiplied by 10 in order to examine regional differences on the scale presented.

Appendix G

Non-Parametric Analyses Data Tables

State ADFG Region Non-Parametric Analyses						w/ Bonferroni Correction				
Resource:	**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**		
Eggs	**9**	**15**	**0.6000**			**7**	**15**	**0.4667**		
Mann-Whitney U p-values										
	2	**3**	**4**	**5**	**6**	**2**	**3**	**4**	**5**	**6**
1	0.8660	<0.0001	0.0026	<0.0001	0.4046	12.99	<0.002	0.039	<0.002	6.069
2		<0.0001	0.0055	<0.0001	0.4681		<0.002	0.0825	<0.002	7.0215
3			0.8769	0.8684	0.0011			13.1535	13.026	0.0165
4				0.8411	0.0323				12.6165	0.4845
5					0.0015					0.0225
Kruskal-Wallis 1-Way ANOVA										
1	42.66	31								
2	44.08	33								
3	99.15	46								
4	102.5	2								
5	98.8	23								
6	48.21	7								
Total =		142	Chi-Square = 64.2011	p = <0.0001						
	w/ Ties		Chi-Square = 70.6716	p = <0.0001						

State ADFG Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%
Feral Animals	**1**	**1**	**1.0000**

Mann-Whitney U p-values

	2	3	4	5	6
1	No Data	No Data	No Data	No Data	No Data
2		0.0160	No Data	No Data	No Data
3			No Data	No Data	No Data
4				No Data	No Data
5					No Data

Kruskal-Wallis 1-Way ANOVA

1	0	0		
2	8.13	8		
3	15.89	18		
4	0	0		
5	0	0		
6	0	0		
Total =		26	Chi-Square = 6.050	p = 0.0140
	w/ Ties		Chi-Square = 6.050	p = 0.0140

w/ Bonferroni Correction

No. p<0.05	Total N	%
1	**1**	**1.0000**

	2	3	4	5	6
1	No Data	No Data	No Data	No Data	No Data
2		0.0160	No Data	No Data	No Data
3			No Data	No Data	No Data
4				No Data	No Data
5					No Data

State ADFG Region Non-Parametric Analyses				w/ Bonferroni Correction		
Resource:	**No. p<0.05**	**Total N**	**%**	**No. p<0.05**	**Total N**	**%**
Large Land Mammals	**7**	**15**	**0.4667**	**3**	**15**	**0.2000**

Mann-Whitney U p-values

	2	**3**	**4**	**5**	**6**	**2**	**3**	**4**	**5**	**6**
1	0.3610	0.1794	0.9202	0.0070	0.0012	5.415	2.691	13.803	0.105	0.018
2		0.0376	0.3730	0.0011	0.0001		0.564	5.595	0.0165	0.0015
3			0.3563	0.1146	0.1605			5.3445	1.719	2.4075
4				0.0375	0.0198				0.5625	0.297
5					0.4361					6.5415

Kruskal-Wallis 1-Way ANOVA

1	77.55	31		
2	69.27	50		
3	93.64	47		
4	76.5	11		
5	121.21	14		
6	117.86	22		
Total =		175	Chi-Square = 22.9641	p = 0.0003
	w/ Ties		Chi-Square = 22.9640	p = 0.0003

State ADFG Region Non-Parametric Analyses						w/ Bonferroni Correction				
Resource:	**No. p<0.05**	**Total N**	%				**No. p<0.05**	**Total N**	%	
Marine Invertebrates	**8**	**15**	**0.5333**				**6**	**15**	**0.4000**	
Mann-Whitney U p-values										
	2	**3**	**4**	**5**	**6**	**2**	**3**	**4**	**5**	**6**
1	<0.0001	<0.0001	0.1437	0.0002	<0.0001	<0.002	<0.002	2.1555	0.003	<0.002
2		<0.0001	0.3265	0.2357	0.0458		<0.002	4.8975	3.5355	0.687
3			0.9137	0.1263	0.0001			13.7055	1.8945	0.0015
4				0.4367	0.0671				6.5505	1.0065
5					0.0045					0.0675
Kruskal-Wallis 1-Way ANOVA										
1	121.45	31								
2	48.36	50								
3	81.73	47								
4	80	1								
5	62.69	8								
6	27.2	10								
Total =		147	Chi-Square = 70.8468	p = <0.0001						
	w/ Ties		Chi-Square = 71.6575	p = <0.0001						

ED_002991_00017357-00077

State ADFG Region Non-Parametric Analyses						w/ Bonferroni Correction				
Resource:	**No. p<0.05**	**Total N**	%				**No. p<0.05**	**Total N**	%	
Marine Mammals	**9**	**10**	**0.9000**				**8**	**10**	**0.8000**	
Mann-Whitney U p-values										
	2	**3**	**4**	**5**	**6**	**2**	**3**	**4**	**5**	**6**
1	0.2129	0.0186	<0.0001	<0.0001	No Data	2.129	0.186	<0.002	<0.002	No Data
2		0.0010	0.0001	<0.0001	No Data		0.01	0.001	<0.002	No Data
3			0.0016	<0.0001	No Data			0.016	<0.002	No Data
4				0.0020	No Data				0.02	No Data
5					No Data					No Data
Kruskal-Wallis 1-Way ANOVA										
1	45	31								
2	35.89	22								
3	61.68	45								
4	94.56	9								
5	112.14	14								
6										
Total =		121	Chi-Square = 55.7518	p = <0.0001						
			Chi-Square = 56.6139	p = <0.0001						

State ADFG Region Non-Parametric Analyses						w/ Bonferroni Correction				
Resource:	**No. p<0.05**	**Total N**	**%**				**No. p<0.05**	**Total N**	**%**	
Migratory Birds	**13**	**15**	**0.8667**				**9**	**15**	**0.6000**	
Mann-Whitney U p-values										
	2	**3**	**4**	**5**	**6**	**2**	**3**	**4**	**5**	**6**
1	0.0002	0.0039	0.0001	<0.0001	0.0131	0.003	0.0585	0.0015	<0.002	0.1965
2		<0.0001	<0.0001	<0.0001	<0.0001		<0.002	<0.002	<0.002	<0.002
3			<0.0001	<0.0001	0.2117			<0.002	<0.002	3.1755
4				0.0056	0.0049				0.084	0.0735
5					0.2084					3.126
Kruskal-Wallis 1-Way ANOVA										
1	76.55	31								
2	44.9	50								
3	100.77	47								
4	169.88	8								
5	143.72	25								
6	115	22								
Total =		183	Chi-Square = 88.7247	p = <0.0001						
			Chi-Square = 88.7749	p = <0.0001						

State ADFG Region Non-Parametric Analyses						w/ Bonferroni Correction				
Resource:		**No. p<0.05**	**Total N**	%			**No. p<0.05**	**Total N**	%	
Non-Salmon Fish		**9**	**15**	**0.6000**			**9**	**15**	**0.6000**	
Mann-Whitney U p-values										
	2	**3**	**4**	**5**	**6**	**2**	**3**	**4**	**5**	**6**
1	<0.0001	0.1429	<0.0001	0.6949	0.6518	<0.002	2.1435	<0.002	10.4235	9.777
2		<0.0001	<0.0001	0.0001	0.0001		<0.002	<0.002	0.0015	0.0015
3			<0.0001	0.2106	0.1529			<0.002	3.159	2.2935
4				0.0007	0.0001				0.0105	0.0015
5					0.9224					13.836
Kruskal-Wallis 1-Way ANOVA										
1	103.29	31								
2	47.74	50								
3	89.17	47								
4	166.67	9								
5	106.86	14								
6	103.41	22								
	Total = 173		Chi-Square = 61.4233	p = <0.0001						
			Chi-Square = 61.4233	p = <0.0001						

State ADFG Region Non-Parametric Analyses				w/ Bonferroni Correction		
Resource:	**No. p<0.05**	**Total N**	**%**	**No. p<0.05**	**Total N**	**%**
Salmon	**10**	**15**	**0.6667**	**6**	**15**	**0.4000**

Mann-Whitney U p-values

	2	**3**	**4**	**5**	**6**	**2**	**3**	**4**	**5**	**6**
1	0.0302	<0.0001	<0.0001	0.4620	0.1019	0.453	<0.002	<0.002	6.93	1.5285
2		<0.0001	<0.0001	0.7088	0.0100		<0.002	<0.002	10.632	0.15
3			0.0150	0.0025	0.8857			0.225	0.0375	13.2855
4				0.0004	0.5423				0.006	8.1345
5					0.0284					0.426

Kruskal-Wallis 1-Way ANOVA

1	72.77	31		
2	56.96	50		
3	119.38	47		
4	146.38	13		
5	62.93	14		
6	105.74	23		
Total =		178	Chi-Square = 60.8631	p = <0.0001
	w/ Ties		Chi-Square = 60.8631	p = <0.0001

ED_002991_00017357-00081

State ADFG Region Non-Parametric Analyses						w/ Bonferroni Correction				
Resource:		**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**	
Non-Migratory Birds		**11**	**15**	**0.7333**			**8**	**15**	**0.5333**	
Mann-Whitney U p-values										
	2	**3**	**4**	**5**	**6**	**2**	**3**	**4**	**5**	**6**
1	<0.0001	<0.0001	0.0012	<0.0001	<0.0001	<0.002	<0.002	0.018	<0.002	<0.002
2		0.6728	0.0033	0.6530	0.0412		10.092	0.0495	9.795	0.618
3			0.0105	0.9764	0.1529			0.1575	14.646	2.2935
4				0.0019	0.0028				0.0285	0.042
5					0.0142					0.213
Kruskal-Wallis 1-Way ANOVA										
1	30.63	31								
2	99.93	50								
3	95.13	47								
4	168.75	4								
5	94.44	25								
6	120.77	22								
Total =		179	Chi-Square = 60.1725		p = <0.0001					
		w/ Ties	Chi-Square = 60.1885		p = <0.0001					

State ADFG Region Non-Parametric Analyses						w/ Bonferroni Correction				
Resource:	**No. p<0.05**	**Total N**	**%**				**No. p<0.05**	**Total N**	**%**	
Small Land Mammals	**12**	**15**	**0.8000**				**11**	**15**	**0.7333**	
Mann-Whitney U p-values										
	2	**3**	**4**	**5**	**6**	**2**	**3**	**4**	**5**	**6**
1	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.002	<0.002	<0.002	<0.002	<0.002
2		0.7343	<0.0001	0.0211	<0.0001		11.0145	<0.002	0.3165	<0.002
3			0.0003	0.0974	0.0003			0.0045	1.461	0.0045
4				<0.0001	0.1467				<0.002	2.2005
5					<0.0001					<0.002
Kruskal-Wallis 1-Way ANOVA										
1	24.66	31								
2	94.46	50								
3	91.69	47								
4	151.09	11								
5	67.93	14								
6	135.91	22								
Total =		175	Chi-Square = 89.4470	p = <0.0001						
	w/ Ties		Chi-Square = 89.4373	p = <0.0001						

State ADFG Region Non-Parametric Analyses						w/ Bonferroni Correction				
Resource:		**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**	
Vegetation		**6**	**15**	**0.4000**			**1**	**15**	**0.0667**	
Mann-Whitney U p-values										
	2	**3**	**4**	**5**	**6**	**2**	**3**	**4**	**5**	**6**
1	0.2378	0.3437	0.0432	0.626	0.0144	3.567	5.1555	0.648	9.39	0.216
2		0.0129	0.0293	0.9078	0.0848		0.1935	0.4395	13.617	1.272
3			0.0734	0.2899	0.0009			1.101	4.3485	0.0135
4				0.0689	0.0173				1.0335	0.2595
5					0.5642					8.463
Kruskal-Wallis 1-Way ANOVA										
1	86.77	31								
2	74.64	50								
3	97.09	44								
4	132.38	4								
5	75.63	12								
6	56.14	22								
Total =		163	Chi-Square = 17.4129	p = 0.0038						
		w/ Ties	Chi-Square = 17.4131	p = 0.0038						

State Eco-cultural Region Non-Parametric Analyses

Resource:		**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**
Eggs		**6**	**10**	**0.6000**			**6**	**10**	**0.6000**
Mann-Whitney U p-values									
	2	**3**	**4**	**5**		**2**	**3**	**4**	**5**
1	0.5712	<0.0001	<0.0001	0.0031		5.712	<0.001	<0.001	0.031
2		<0.0001	<0.0001	0.0029			<0.001	<0.001	0.029
3			0.5824	0.7819				5.824	7.819
4				0.8396					8.396
Kruskal-Wallis 1-Way ANOVA									
1	99.24	46							
2	96.91	29							
3	40.09	32							
4	43.00	30							
5	40.90	5							
Total =		142	Chi-Square = 67.8052		p = <0.0001				
		w/ Ties	Chi-Square = 74.6389		p = <0.0001				

State Eco-cultural Region Non-Parametric Analyses					
Resource:					
Feral Animals					
Kruskal-Wallis 1-Way ANOVA					
1	20.00		2		
2	12.98		23		
3	0.00		0		
4	0.00		0		
5	12.50		1		
Total =			26	Chi-Square = 1.663	p = 0.435
		w/ Ties		Chi-Square = 1.663	p = 0.435

State Eco-cultural Region Non-Parametric Analyses									
Resource:		**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**
Large Land Mammals		**9**	**10**	**0.9000**			**5**	**10**	**0.5000**
Mann-Whitney U p-values									
	2	**3**	**4**	**5**		**2**	**3**	**4**	**5**
1	<0.0001	0.0349	0.0017	0.0006		<0.001	0.349	0.017	0.006
2		<0.0001	0.0131	0.8830			<0.001	0.131	8.83
3			0.0365	0.0007				0.365	0.007
4				0.0322					0.322
Kruskal-Wallis 1-Way ANOVA									
1	114.90	46							
2	51.95	31							
3	100.11	54							
4	79.27	30							
5	51.43	14							
Total =		175	Chi-Square = 39.9385		p = <0.0001				
	w/ Ties		Chi-Square = 39.9388		p = <0.0001				

State Eco-cultural Region Non-Parametric Analyses									
Resource:		**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**
Marine Invertebrates		**9**	**10**	**0.9000**			**9**	**10**	**0.9000**
Mann-Whitney U p-values									
	2	**3**	**4**	**5**		**2**	**3**	**4**	**5**
1	<0.0001	<0.0001	<0.0001	0.4564		<0.001	<0.001	<0.001	4.564
2		<0.0001	0.0007	<0.0001			<0.001	0.007	<0.001
3			<0.0001	<0.0001				<0.001	<0.001
4				<0.0001					<0.001
Kruskal-Wallis 1-Way ANOVA									
1	58.60	30							
2	105.94	31							
3	29.96	42							
4	122.60	30							
5	64.25	14							
Total =		147	Chi-Square = 106.1030		p = <0.0001				
		w/ Ties	Chi-Square = 107.3170		p = <0.0001				

State Eco-cultural Region Non-Parametric Analyses									
Resource:	**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**	
Marine Mammals	**8**	**10**	**0.8000**			**6**	**10**	**0.6000**	
Mann-Whitney U p-values									
	2	**3**	**4**	**5**	**2**	**3**	**4**	**5**	
1	0.0279	0.0075	<0.0001	<0.0001	0.279	0.075	<0.001	<0.001	
2		0.0049	0.0010	<0.0001		0.049	0.01	<0.001	
3			0.1420	0.7155			1.42	7.155	
4				0.0038				0.038	
Kruskal-Wallis 1-Way ANOVA									
1	82.14	44							
2	70.10	29							
3	24.38	4							
4	44.83	30							
5	20.82	14							
Total =		121	Chi-Square = 47.0399	p = <0.0001					
			Chi-Square = 47.7476	p = <0.0001					

State Eco-cultural Region Non-Parametric Analyses

Resource:		No. p<0.05	Total N	%			No. p<0.05	Total N	%
Migratory Birds		**7**	**10**	**0.7000**			**6**	**10**	**0.6000**
Mann-Whitney U p-values									
	2	**3**	**4**	**5**		**2**	**3**	**4**	**5**
1	<0.0001	<0.0001	<0.0001	<0.0001		<0.001	<0.001	<0.001	<0.001
2		0.0606	0.0847	0.0001			0.606	0.847	0.001
3			0.3338	0.0183				3.338	0.183
4				0.0005					0.005
Kruskal-Wallis 1-Way ANOVA									
1	132.17	54							
2	92.66	31							
3	74.18	54							
4	77.65	30							
5	35.11	14							
Total =		183	Chi-Square = 93.0185		p = <0.0001				
			Chi-Square = 93.0397		p = <0.0001				

State Eco-cultural Region Non-Parametric Analyses

Resource:		**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**
Non-Salmon Fish		**8**	**10**	**0.8000**			**6**	**10**	**0.6000**
Mann-Whitney U p-values									
	2	3	4	5		**2**	**3**	**4**	**5**
1	<0.0001	0.9385	0.0297	<0.0001		<0.001	9.385	0.297	<0.001
2		0.0027	0.5639	<0.0001			0.027	5.639	<0.001
3			0.0010	0.0453				0.01	0.453
4				<0.0001					0
Kruskal-Wallis 1-Way ANOVA									
1	106.27	44							
2	100.58	31							
3	67.56	54							
4	105.37	30							
5	32.00	14							
Total = 173			Chi-Square = 37.8503		p = <0.0001				
			Chi-Square = 37.8503		p = <0.0001				

ED_002991_00017357-00091

State Eco-cultural Region Non-Parametric Analyses									
Resource:		**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**
Salmon		**6**	**10**	**0.6000**			**5**	**10**	**0.5000**
Mann-Whitney U p-values									
	2	3	4	5		**2**	**3**	**4**	**5**
1	0.0707	0.0651	0.0002	0.0004		0.707	0.651	0.002	0.004
2		0.0583	0.0007	<0.0001			0.583	0.007	<0.001
3			0.9780	0.0305				9.78	0.305
4				0.0009					0.009
Kruskal-Wallis 1-Way ANOVA									
1	110.90	48							
2	104.35	31							
3	83.29	55							
4	74.00	30							
5	40.86	14							
Total =		178	Chi-Square = 26.8412		p=<0.0001				
	w/ Ties		Chi-Square = 26.8412		p=<0.0001				

State Eco-cultural Region Non-Parametric Analyses									
Resource:		**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**
Non-Migratory Birds		**7**	**10**	**0.7000**			**6**	**10**	**0.6000**
Mann-Whitney U p-values									
	2	3	4	5		**2**	**3**	**4**	**5**
1	0.0006	0.9197	<0.0001	0.3893		0.006	9.197	<0.001	3.893
2		<0.0001	0.0002	0.0282			<0.001	0.002	0.282
3			<0.0001	0.2748				<0.001	2.748
4				<0.0001					<0.001
Kruskal-Wallis 1-Way ANOVA									
1	109.44	50							
2	68.53	31							
3	114.46	54							
4	31.47	30							
5	99.18	14							
Total =		179	Chi-Square = 63.1143		p = <0.0001				
	w/ Ties		Chi-Square = 63.1282		p = <0.0001				

State Eco-cultural Region Non-Parametric Analyses									
Resource:	**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**	
Small Land Mammals	**8**	**10**	**0.8000**			**7**	**10**	**0.7000**	
Mann-Whitney U p-values									
	2	3	4	5		**2**	**3**	**4**	**5**
1	<0.0001	0.5451	<0.0001	0.0079		<0.001	5.451	<0.001	0.079
2		<0.0001	<0.0001	0.1020			<0.001	<0.001	1.02
3			<0.0001	0.0001				<0.001	0.001
4				<0.0001					<0.001
Kruskal-Wallis 1-Way ANOVA									
1	112.73	46							
2	56.00	31							
3	123.54	54							
4	24.82	30							
5	75.93	14							
Total =		175	Chi-Square = 97.3528	p = <0.0001					
	w/ Ties		Chi-Square = 98.4428	p = <0.0001					

State Eco-cultural Region Non-Parametric Analyses								
Resource:	**No. p<0.05**	**Total N**	**%**			**No. p<0.05**	**Total N**	**%**
Vegetation	**4**	**10**	**0.4000**			**1**	**10**	**0.1000**
Mann-Whitney U p-values								
	2	**3**	**4**	**5**	**2**	**3**	**4**	**5**
1	0.0057	0.0019	0.0871	0.0084	0.057	0.019	0.871	0.084
2		0.4357	0.2675	0.0765		4.357	2.675	0.765
3			0.1104	0.2682			1.104	2.682
4				0.0322				0.322
Kruskal-Wallis 1-Way ANOVA								
1	105.69	35						
2	77.63	30						
3	71.79	54						
4	88.70	30						
5	57.18	14						
Total =		163	Chi-Square = 16.0761	p = 0.0029				
	w/ Ties		Chi-Square = 16.0762	p = 0.0029				

Federal Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%
Eggs	**18**	**36**	**0.5000**

Mann-Whitney U p-values

	2	3	4	5	6	7	8	9	10
1	0.8660	<0.0001	<0.0001	0.0026	No Data	<0.0001	0.0209	0.4046	0.0026
2		<0.0001	<0.0001	0.0055	No Data	<0.0001	0.0282	0.4681	0.0026
3			0.8846	0.9046	No Data	0.1202	0.1252	0.0002	0.4729
4				0.7295	No Data	0.5532	0.1270	0.0109	0.7548
5					No Data	0.3958	0.5515	0.0323	0.5637
6						No Data	No Data	No Data	No Data
7							0.0291	0.0003	0.2012
8								0.1949	0.4193
9									0.0255

Kruskal-Wallis 1-Way ANOVA

1	42.66	31
2	44.08	33
3	102.76	19
4	96.61	27
5	102.50	2
6	0.00	0
7	113.58	13
8	73.00	7
9	48.21	7
10	95.00	3

Total =	142	Chi-Square	= 68.9072	p = <0.0001
	w/ Ties	Chi-Square	= 75.8520	p = <0.0001

No. p<0.05	Total N	%
8	**36**	**0.2222**

	2	3	4	5	6	7	8	9	10
1	31.176	<0.005	<0.005	0.0936	No Data	<0.005	0.7524	14.5656	0.0936
2		<0.005	<0.005	0.198	No Data	<0.005	1.0152	16.8516	0.0936
3			31.8456	32.5656	No Data	4.3272	4.5072	0.0072	17.0244
4				26.262	No Data	19.9152	4.572	0.3924	27.1728
5					No Data	14.2488	19.854	1.1628	20.2932
6						No Data	No Data	No Data	No Data
7							1.0476	0.0108	7.2432
8								7.0164	15.0948
9									0.918

Federal Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%							No. p<0.05	Total N	%						
Feral Animals	1	1	1.000							1	1	1.000						

Mann-Whitney U p-values

	2	3	4	5	6	7	8	9	10	2	3	4	5	6	7	8	9	10
1	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
2		0.0160	No Data	No Data	No Data	No Data	No Data	No Data	No Data		0.0160	No Data	No Data	No Data	No Data	No Data	No Data	No Data
3			No Data	No Data	No Data	No Data	No Data	No Data	No Data			No Data	No Data	No Data	No Data	No Data	No Data	No Data
4				No Data	No Data	No Data	No Data	No Data	No Data				No Data	No Data	No Data	No Data	No Data	No Data
5					No Data	No Data	No Data	No Data	No Data					No Data	No Data	No Data	No Data	No Data
6						No Data	No Data	No Data	No Data						No Data	No Data	No Data	No Data
7							No Data	No Data	No Data							No Data	No Data	No Data
8								No Data	No Data								No Data	No Data
9									No Data									No Data

Kruskal-Wallis 1-Way ANOVA

1	0	0			
2	8.13	8			
3	15.89	18			
4	0	0			
5	0	0			
6	0.00	0			
7	0	0			
8	0	0			
9	0	0			
10	0	0			
Total =		26	Chi-Square	= 6.050	p = 0.0140
	w/ Ties		Chi-Square	= 6.050	p = 0.0140

Federal Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%		No. p<0.05	Total N	%
Large Land Mammals	30	45	0.6667		11	43	0.2558

Mann-Whitney U p-values

	2	3	4	5	6	7	8	9	10
1	0.3169	0.0026	<0.0001	0.3731	0.0002	0.4504	0.0019	0.0223	0.0024
2		0.0054	<0.0001	0.7122	<0.0001	0.7474	0.0010	0.0019	0.0008
3			<0.0001	0.1088	0.0001	0.2767	0.0019	0.0001	0.0011
4				0.0005	0.5712	0.0182	0.1255	0.0248	0.6971
5					0.0013	0.7389	0.0055	0.0157	0.0063
6						0.0136	0.3545	0.0113	0.9468
7							0.0143	0.1266	0.0283
8								0.0051	0.2207
9									0.0260

	2	3	4	5	6	7	8	9	10
1	14.2605	0.117	<0.005	16.7895	0.009	20.268	0.0855	1.0035	
2		0.243	<0.005	32.049	0	33.633	0.045	0.0855	0.036
3			<0.005	4.896	0.0045	12.4515	0.0855	0.0045	0.0495
4				0.0225	25.704	0.819	5.6475	1.116	31.3695
5					0.0585	33.2505	0.2475	0.7065	0.2835
6						0.612	15.9525	0.5085	42.606
7							0.6435	5.697	1.2735
8								0.2295	9.9315
9									1.17

Kruskal-Wallis 1-Way ANOVA

1	77.55	31			
2	68.37	50			
3	40.70	20			
4	132.85	27			
5	63.61	9			
6	144.33	9			
7	64.80	5			
8	161.25	4			
9	107.20	15			
10	145.60	5			
Total =		175	Chi-Square	= 78.6626	p = <0.0001
	w/ Ties		Chi-Square	= 78.6631	p = <0.0001

Federal Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%	No. p<0.05	Total N	%
Marine Invertebrates	**16**	**28**	**0.5714**	**7**	**28**	**0.2500**

Mann-Whitney U p-values

	2	3	4	5	6	7	8	9	10
1	<0.0001	0.0069	<0.0001	0.1437	No Data	0.0196	0.0013	<0.0001	No Data
2		<0.0001	0.0361	0.3265	No Data	0.0221	0.5875	0.0458	No Data
3			0.0001	0.2477	No Data	0.1632	0.0019	<0.0001	No Data
4				0.4939	No Data	0.1558	0.0760	0.0033	No Data
5					No Data	1	0.1468	0.0671	No Data
6						No Data	No Data	No Data	No Data
7							0.0202	0.0041	No Data
8								0.0696	No Data
9									No Data

	2	3	4	5	6	7	8	9	10
1	<0.005	0.1932	<0.005	4.0236	No Data	0.5488	0.0364	<0.005	No Data
2		<0.005	1.0108	9.142	No Data	0.6188	16.45	1.2824	No Data
3			0.0028	6.9356	No Data	4.5696	0.0532	<0.005	No Data
4				13.8292	No Data	4.3624	2.128	0.0924	No Data
5					No Data	28	4.1104	1.8788	No Data
6						No Data	No Data	No Data	No Data
7							0.5656	0.1148	No Data
8								1.9488	No Data
9									No Data

Kruskal-Wallis 1-Way ANOVA

1	121.45	31			
2	48.36	50			
3	104.60	20			
4	64.80	27			
5	80.00	1			
6	0.00	0			
7	87.88	4			
8	37.50	4			
9	27.20	10			
10	0.00	0			
	Total =	147	Chi-Square	= 83.6865	p = <0.0001
		w/ Ties	Chi-Square	= 84.644	p = <0.0001

Federal Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%
Marine Mammals	20	28	0.7143

Resource (right panel)	No. p<0.05	Total N	%
Marine Mammals	13	28	0.4643

Mann-Whitney U p-values

	2	3	4	5	6	7	8	9	10
1	0.2129	0.0003	0.4368	<0.0001	No Data	0.0003	0.0011	No Data	0.0003
2		<0.0001	0.0541	0.0001	No Data	0.0004	0.0019	No Data	0.0004
3			0.0034	0.0570	No Data	0.0008	0.0171	No Data	0.0029
4				0.0003	No Data	0.0004	0.0020	No Data	0.0006
5					No Data	0.0063	0.1228	No Data	0.0136
6						No Data	No Data	No Data	No Data
7							0.2207	No Data	0.4647
8								No Data	0.4624
9									No Data

	2	3	4	5	6	7	8	9	10
1	5.9612	0.0084	12.2304	<0.005	No Data	0.0084	0.0308	No Data	0.0084
2		<0.005	1.5148	0.0028	No Data	0.0112	0.0532	No Data	0.0112
3			0.0952	1.596	No Data	0.0224	0.4788	No Data	0.0812
4				0.0084	No Data	0.0112	0.056	No Data	0.0168
5					No Data	0.1764	3.4384	No Data	0.3808
6						No Data	No Data	No Data	No Data
7							6.1796	No Data	13.0116
8								No Data	12.9472
9									No Data

Kruskal-Wallis 1-Way ANOVA

1	45.00	31
2	35.89	22
3	77.56	18
4	51.09	27
5	94.56	9
6	0.00	0
7	115.80	5
8	107.50	4
9	0.00	0
10	112.20	5
Total =		121

Chi-Square = 62.0243 p = <0.0001

Chi-Square = 62.9834 p = <0.0001

Federal Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%		No. p<0.05	Total N	%
Migratory Birds	25	44	0.5682		15	44	0.3409

Mann-Whitney U p-values

	2	3	4	5	6	7	8	9	10
1	4.0000	0.1072	0.0019	0.0001	0.0013	<0.0001	0.0031	0.2275	0.0011
2		0.0001	<0.0001	<0.0001	0.0001	<0.0001	0.0001	0.0008	0.0003
3			0.4259	0.0001	0.0128	0.0004	0.0766	0.6527	0.0022
4				<0.0001	0.0283	0.0008	0.1536	0.7034	0.0024
5					0.0641	0.0113	0.0055	0.0045	0.3055
6						0.7241	0.1417	0.1127	0.8075
7							0.1655	0.0621	0.3007
8								0.3413	0.0882
9									0.0887

	2	3	4	5	6	7	8	9	10
1	176	4.7168	0.0836	0.0044	0.0572	<0.005	0.1364	10.01	0.0484
2		0.0044	<0.005	<0.005	0.0044	<0.005	0.0044	0.0352	0.0132
3			18.7396	0.0044	0.5632	0.0176	3.3704	28.7188	0.0968
4				<0.005	1.2452	0.0352	6.7584	30.9496	0.1056
5					2.8204	0.4972	0.242	0.198	13.442
6						31.8604	6.2348	4.9588	35.53
7							7.282	2.7324	13.2308
8								15.0172	3.8808
9									3.9028

Kruskal-Wallis 1-Way ANOVA

1	76.55	31
2	45.14	50
3	94.00	20
4	105.78	27
5	169.88	8
6	144.57	7
7	146.08	13
8	128.57	7
9	100.40	15
10	158.80	5
Total =		183

Chi-Square = 93.0185 p = <0.0001

Chi-Square = 93.0397 p = <0.0001

Federal Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%	No. p<0.05	Total N	%
Non-Salmon Fish	17	45	0.3778	9	43	0.2093

Mann-Whitney U p-values

	2	3	4	5	6	7	8	9	10	2	3	4	5	6	7	8	9	10
1	<0.0001	0.9385	0.0297	<0.0001	0.7205	0.6639	0.2134	0.4189	0.4234	<0.005	42.2325	1.3365	<0.005	32.4225	29.8755	9.603	18.8505	19.053
2		<0.0001	0.0018	<0.0001	0.0548	0.0092	0.0050	0.0002	0.0533		<0.005	0.081	<0.005	2.466	0.414	0.225	0.009	2.3985
3			0.1066	<0.0001	0.7821	0.7341	0.3139	0.4634	0.4149			4.797	<0.005	35.1945	33.0345	14.1255	20.853	18.6705
4				<0.0001	0.5369	0.1391	0.0593	0.0475	0.7359				<0.005	24.1605	6.2595	2.6685	2.1375	33.1155
5					0.0009	0.0093	0.0206	0.0003	0.0093					0.0405	0.4185	0.927	0.0135	0.4185
6						0.4649	0.3447	0.3067	0.9353						20.9205	15.5115	13.8015	42.0885
7							0.6242	0.8273	0.4647							28.089	37.2285	20.9115
8								0.4839	0.2207								21.7755	9.9315
9									0.3155									14.1975

Kruskal-Wallis 1-Way ANOVA

1	103.29	31
2	47.84	50
3	102.10	20
4	79.59	27
5	166.67	9
6	90.29	7
7	110.20	5
8	126.50	4
9	109.20	15
10	87.80	5

Total = 173	Chi-Square	= 65.5643	p = <0.0001
	Chi-Square	= 65.5643	p = <0.0001

Federal Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%							No. p<0.05	Total N	%						
Salmon	**24**	**45**	**0.5333**							**12**	**43**	**0.2791**						

Mann-Whitney U p-values

	2	3	4	5	6	7	8	9	10	2	3	4	5	6	7	8	9	10
1	0.0173	0.0135	<0.0001	<0.0001	0.0002	0.1630	0.3781	0.5502	0.0004	0.7785	0.6075	<0.005	<0.005	0.009	7.335	17.0145	24.759	0.018
2		0.0003	<0.0001	<0.0001	<0.0001	0.0465	0.2094	0.1195	0.0003		0.0135	<0.005	<0.005	<0.005	2.0925	9.423	5.3775	0.0135
3			0.0010	0.0005	0.0024	0.7858	0.7567	0.9468	0.0014			0.045	0.0225	0.108	35.361	34.0515	42.606	0.063
4				0.5094	0.1238	0.1391	0.0518	0.1009	0.0005				22.923	5.571	6.2595	2.331	4.5405	0.0225
5					0.1809	0.1004	0.0188	0.1535	0.0018					8.1405	4.518	0.846	6.9075	0.081
6						0.0662	0.0339	0.1077	0.0022						2.979	1.5255	4.8465	0.099
7							0.6242	0.9652	0.0090							28.089	43.434	0.405
8								0.8415	0.0143								37.8675	0.6435
9									0.0078									0.351

Kruskal-Wallis 1-Way ANOVA

1	72.77	31			
2	55.32	50			
3	96.85	20			
4	136.07	27			
5	144.45	11			
6	144.90	10			
7	101.40	5			
8	87.25	4			
9	91.93	15			
10	5.00	5			
Total =		178	Chi-Square	= 85.5552	p = <0.0001
	w/ Ties		Chi-Square	= 85.5552	p = <0.0001

ED_002991_00017357-00103

Federal Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%	No. p<0.05	Total N	%
Non-Migratory Birds	27	45	0.6000	9	43	0.2093

Mann-Whitney U p-values

	2	3	4	5	6	7	8	9	10
1	<0.0001	0.0079	<0.0001	0.0012	0.0003	<0.0001	0.0004	<0.0001	0.0026
2		0.0009	0.0453	0.0033	0.9225	0.8651	0.4959	0.0145	0.8148
3			0.0010	0.0066	0.0598	0.0325	0.0462	0.0007	0.1027
4				0.0251	0.0670	0.0605	0.0670	0.8234	0.5165
5					0.0082	0.0046	0.0082	0.0051	0.0143
6						0.9054	0.6547	0.0043	0.4649
7							0.5006	0.0081	0.8053
8								0.0053	0.5698
9									0.3153

	2	3	4	5	6	7	8	9	10
1	<0.005	0.3555	<0.005	0.054	0.0135	<0.005	0.018	<0.005	0.117
2		0.0405	2.0385	0.1485	41.5125	38.9295	22.3155	0.6525	36.666
3			0.045	0.297	2.691	1.4625	2.079	0.0315	4.6215
4				1.1295	3.015	2.7225	3.015	37.053	23.2425
5					0.369	0.207	0.369	0.2295	0.6435
6						40.743	29.4615	0.1935	20.9205
7							22.527	0.3645	36.2385
8								0.2385	25.641
9									14.1885

Kruskal-Wallis 1-Way ANOVA

1	30.63	31				
2	100.53	50				
3	62.00	20				
4	119.67	27				
5	168.75	4				
6	94.21	7				
7	94.81	13				
8	88.64	7				
9	131.17	15				
10	101.60	5				
Total =		179	Chi-Square	= 76.5723		p = <0.0001
	w/ Ties		Chi-Square	= 76.5891		p = <0.0001

Federal Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%		No. p<0.05	Total N	%
Small Land Mammals	**31**	**45**	**0.6889**		**16**	**42**	**0.3810**

Mann-Whitney U p-values

	2	3	4	5	6	7	8	9	10
1	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0016	<0.0001	0.0004
2		0.0002	0.0090	0.0001	0.0006	0.8376	0.0513	0.0002	0.0281
3			<0.0001	<0.0001	<0.0001	0.0687	0.9058	<0.0001	0.9725
4				0.0465	0.2210	0.1134	0.0184	0.1602	0.0047
5					0.4015	0.0063	0.0055	0.4561	0.0027
6						0.0196	0.0055	0.9762	0.0027
7							0.1416	0.0207	0.1745
8								0.0051	0.5386
9									0.0014

	2	3	4	5	6	7	8	9	10
1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.072	<0.005	0.018
2		0.009	0.405	0.0045	0.027	37.692	2.3085	0.009	1.2645
3			<0.005	<0.005	<0.005	3.0915	40.761	<0.005	43.7625
4				2.0925	9.945	5.103	0.828	7.209	0.2115
5					18.0675	0.2835	0.2475	20.5245	0.1215
6						0.882	0.2475	43.929	0.1215
7							6.372	0.9315	7.8525
8								0.2295	24.237
9									0.063

Kruskal-Wallis 1-Way ANOVA

1	24.66	31			
2	94.12	50			
3	54.35	20			
4	119.35	27			
5	149.11	9			
6	140.44	9			
7	89.90	5			
8	56.75	4			
9	137.53	15			
10	54.90	5			
Total =		175	Chi-Square	= 109.0888	p = <0.0001
	w/ Ties		Chi-Square	= 110.3102	p = <0.0001

Federal Region Non-Parametric Analyses

Resource:	No. p<0.05	Total N	%		No. p<0.05	Total N	%
Vegetation	22	45	0.4889		4	44	0.0909

Mann-Whitney U p-values

	2	3	4	5	6	7	8	9	10
1	0.2013	0.1838	0.0109	0.0432	0.4401	0.0779	0.6407	0.0139	0.0016
2		0.7625	0.0001	0.0269	0.9419	0.0269	0.3725	0.0812	0.0011
3			0.0002	0.0516	0.8851	0.0426	0.1233	0.1145	0.0021
4				0.1290	0.0381	0.4479	0.1138	0.0001	0.0036
5					0.0890	0.3865	0.2482	0.0187	0.0209
6						0.1859	0.3447	0.4592	0.0082
7							0.2482	0.0164	0.0209
8								0.0357	0.0029
9									0.0037

	2	3	4	5	6	7	8	9	10
1	9.0585	8.271	0.4905	1.944	19.8045	3.5055	28.8315	0.6255	0.072
2		34.3125	0.0045	1.2105	42.3855	1.2105	16.7625	3.654	0.0495
3			0.009	2.322	39.8295	1.917	5.5485	5.1525	0.0945
4				5.805	1.7145	20.1555	5.121	0.0045	0.162
5					4.005	17.3925	11.169	0.8415	0.9405
6						8.3655	15.5115	20.664	0.369
7							11.169	0.738	0.9405
8								1.6065	0.1305
9									0.1665

Kruskal-Wallis 1-Way ANOVA

1	86.77	31			
2	73.66	50			
3	69.97	19			
4	117.70	25			
5	132.38	4			
6	72.29	7			
7	126.50	4			
8	96.00	4			
9	51.87	14			
10	4.38	4			
Total =		163	Chi-Square	= 43.1095	p = <0.0001
	w/ Ties		Chi-Square	= 43.1100	p = <0.0001

Appendix H

Non-Parametric Analyses Ranking Tables

Table 26: Uncorrected non-parametric pairwise comparison ranks for all major resource categories and for top five major resource categories

	Fraction of Significantly different ADFG Sub-regions		Fraction of Significantly different Eco-Cult Sub-regions		Fraction of Significantly different Federal Sub-regions		ADFG Rank	Eco Rank	Fed Rank
Eggs	9 of 15	0.6000	6 of 10	0.6000	0 of 26	<0.0001	1.5	1.5	3
Large Land Mammals	7 of 15	0.4667	9 of 10	0.9000	30 of 45	0.6667	3	1	2
Marine Invertebrates	8 of 15	0.5333	9 of 10	0.9000	16 of 28	0.5714	3	1	2
Marine Mammals	9 of 10	0.9000	8 of 10	0.8000	20 of 28	0.7143	1	2	3
Migratory Birds	13 of 15	0.8667	7 of 10	0.7000	26 of 44	0.5778	1	2	3
Non-Salmon Fish	9 of 15	0.6000	8 of 10	0.8000	17 of 45	0.3778	2	1	3
Salmon	10 of 15	0.6667	6 of 10	0.6000	24 of 45	0.5333	1	2	3
Non-Migratory Birds	11 of 15	0.7333	7 of 10	0.7000	27 of 45	0.6000	1	2	3
Small Land Mammals	12 of 15	0.8000	8 of 10	0.8000	31 of 45	0.6889	1.5	1.5	3
Feral Animals	1 of 1	1.0000			1 of 1	1.0000	1.5	3	1.5
Vegetation	6 of 15	0.4000	4 of 10	0.4000	22 of 45	0.4889	2.5	2.5	1
							19	19.5	27.5

	Fraction of Significantly different ADFG Sub-regions		Fraction of Significantly different Eco-Cult Sub-regions		Fraction of Significantly different Federal Sub-regions		ADFG Rank	Eco Rank	Fed Rank
Large Land Mammals	7 of 15	0.4667	9 of 10	0.9000	30 of 45	0.6667	3	1	2
Marine Invertebrates	8 of 15	0.5333	9 of 10	0.9000	16 of 28	0.5714	3	1	2
Marine Mammals	9 of 10	0.9000	8 of 10	0.8000	20 of 28	0.7143	1	2	3
Non-Salmon Fish	9 of 15	0.6000	8 of 10	0.8000	17 of 45	0.3778	2	1	3
Salmon	10 of 15	0.6667	6 of 10	0.6000	24 of 45	0.5333	1	2	3
							10	7	13

Table 27: Bonferroni corrected non-parametric pairwise comparison ranks for all major resource categories and for top five major resource categories

	Fraction of Significantly different ADFG Sub-regions		Fraction of Significantly different Eco-Cult Sub-regions		Fraction of Significantly different Federal Sub-regions		ADFG Rank	Eco Rank	Fed Rank
Eggs	7 of 15	0.4667	6 of 10	0.6000	8 of 36	0.2222	2	1	3
Large Land Mammals	3 of 15	0.2000	5 of 10	0.5000	11 of 43	0.2558	3	1	2
Marine Invertebrates	6 of 15	0.4000	9 of 10	0.9000	7 of 28	0.2500	2	1	3
Marine Mammals	8 of 10	0.8000	6 of 10	0.6000	13 of 28	0.4643	1	2	3
Migratory Birds	9 of 15	0.6000	6 of 10	0.6000	16 of 44	0.3556	1.5	1.5	3
Non-Salmon Fish	9 of 15	0.6000	6 of 10	0.6000	9 of 43	0.2093	1.5	1.5	3
Salmon	6 of 15	0.4000	5 of 10	0.5000	12 of 43	0.2791	2	1	3
Non-Migratory Birds	8 of 15	0.5333	6 of 10	0.6000	9 of 43	0.2093	2	1	3
Small Land Mammals	11 of 15	0.7333	7 of 10	0.7000	16 of 42	0.3810	1	2	3
Feral Animals	1 of 1	1.0000			1 of 1	1.0000	1.5	3	1.5
Vegetation	1 of 15	0.0667	1 of 10	0.1000	4 of 44	0.0909	3	1	2
							20.5	16	29.5

	Fraction of Significantly different ADFG Sub-regions		Fraction of Significantly different Eco-Cult Sub-regions		Fraction of Significantly different Federal Sub-regions		ADFG Rank	Eco Rank	Fed Rank
Large Land Mammals	3 of 15	0.2000	5 of 10	0.5000	11 of 43	0.2558	3	1	2
Marine Invertebrates	6 of 15	0.4000	9 of 10	0.9000	7 of 28	0.2500	2	1	3
Marine Mammals	8 of 10	0.8000	6 of 10	0.6000	13 of 28	0.4643	1	2	3
Non-Salmon Fish	9 of 15	0.6000	6 of 10	0.6000	9 of 43	0.2093	1.5	1.5	3
Salmon	6 of 15	0.4000	5 of 10	0.5000	12 of 43	0.2791	2	1	3
							9.5	6.5	14

Appendix I

Parametric Analysis Data Tables

Two-Sample t-Test for Community Per Capita Salmon Harvest
Grouped by ADFG Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5	6
1	.015	<.001	<.001	.084	.783
2		<.001	<.001	.221	.467
3			.008	.007	.391
4				<.001	.101
5					.160

Two-Sample t-Test for Community Per Capita Non-Salmon Fish Harvest
Grouped by ADFG Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5	6
1	<.001	.123	<.001	.568	.990
2		<.001	<.001	<.001	<.001
3			<.001	.157	.352
4				<.001	<.001
5					.636

Two-Sample t-Test for Community Per Capita Marine Mammal Harvest
Grouped by ADFG Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5	6
1	.277	.033	<.001	<.001	N/A
2		.003	<.001	<.001	N/A
3			<.001	<.001	N/A
4				.009	N/A
5					N/A

Two-Sample t-Test for Community Per Capita Marine Invertebrate Harvest
Grouped by ADFG Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5	6
1	<.001	<.001	N/A	.003	<.001
2		<.001	N/A	.006	.036
3			N/A	.603	<.001
4				N/A	N/A
5					<.001

Two-Sample t-Test for Community Per Capita Non-Salmon Fish Harvest
Grouped by Eco-Cultural Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5
1	.275	<.001	.408	<.001
2		<.001	.701	<.001
3			<.001	.008
4				<.001

Two-Sample t-Test for Community Per Capita Large Land Mammal Harvest
Grouped by Eco-Cultural Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5
1	.024	.750	.455	.056
2		.007	.038	.222
3			.018	.001
4				.058

Two-Sample t-Test for Community Per Capita Marine Mammal Harvest
Grouped by Eco-Cultural Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5
1	.902	.041	<.001	<.001
2		.039	<.001	<.001
3			.188	.891
4				.002

Two-Sample t-Test for Community Per Capita Marine Invertebrate Harvest
Grouped by Eco-Cultural Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5
1	<.001	<.001	<.001	.605
2		<.001	.008	.009
3			<.001	<.001
4				.003

Two-Sample t-Test for Community Per Capita Salmon Harvest
Grouped by Federal Subsistence Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5	6	7	8	9	10
1	.007	.414	<.001	<.001	<.001	.344	.949	.726	.001
2		.033	<.001	<.001	<.001	.131	.656	.958	<.001
3			.002	<.001	.003	.607	.731	.574	<.001
4				.619	.291	.209	.173	.131	<.001
5					.439	.166	.153	.110	<.001
6						.094	.010	.073	<.001
7							.534	.433	<.001
8								.807	.008
9									.008

Two-Sample t-Test for Community Per Capita Non-Salmon Fish Harvest
Grouped by Federal Subsistence Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5	6	7	8	9	10
1	<.001	.930	.019	<.001	.455	.651	.266	.596	.672
2		<.001	<.001	<.001	.129	.030	.015	<.001	.116
3			.043	<.001	.447	.688	.273	.662	.654
4				<.001	.862	.210	.077	.064	.671
5					.002	.015	.048	<.001	.010
6						.375	.158	.339	.835
7							.057	.914	.515
8								.430	.243
9									.509

Two-Sample t-Test for Community Per Capita Large Land Mammal Harvest
Grouped by Federal Subsistence Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5	6	7	8	9	10
1	.337	.021	<.001	.560	<.001	.654	<.001	.013	.001
2		.030	<.001	.873	<.001	.894	<.001	<.001	<.001
3			.003	.028	.002	.048	<.001	.007	.002
4				<.001	.339	.066	.025	.026	.541
5					<.001	.848	<.001	.012	<.001
6						.043	.238	.011	.759
7							.020	.200	.051
8								<.001	.148
9									.032

Two-Sample t-Test for Community Per Capita Marine Mammal Harvest
Grouped by Federal Subsistence Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5	6	7	8	9	10
1	.227	<.001	.519	<.001	N/A	<.001	<.001	N/A	<.001
2		<.001	.104	<.001	N/A	<.001	<.001	N/A	<.001
3			<.001	.024	N/A	<.001	.007	N/A	<.001
4				<.001	N/A	<.001	<.001	N/A	<.001
5					N/A	.002	.194	N/A	.017
6						N/A	N/A	N/A	N/A
7							.179	N/A	.442
8								N/A	.399
9									N/A

Two-Sample t-Test for Community Per Capita Marine Invertebrate Harvest
Grouped by Federal Subsistence Regions
P(T <= t) two-tail test evaluated at α=.05

Regions	2	3	4	5	6	7	8	9	10
1	<.001	.016	<.001	N/A	N/A	.093	<.001	<.001	N/A
2		<.001	.053	N/A	N/A	<.001	.076	.036	N/A
3			<.001	N/A	N/A	.345	<.001	<.001	N/A
4				N/A	N/A	.012	.337	.002	N/A
5					N/A	N/A	N/A	N/A	N/A
6						N/A	N/A	N/A	N/A
7							.004	<.001	N/A
8								.005	N/A
9									N/A

Appendix J: Wet weight conversion factors

Resource Code	Food Name	Wet Weight Conversion
110000000	**Salmon**	
	FISH CAKES, FRIED	0.59
	FISH INTESTINES, SIMMERED	1.27
	FISH SOUP	0.25
	FISH, FERMENTED	1.06
	KING SALMON KIPPERED	1.43
	SALMON KING DRY FLESH	5.63
	SALMON KING ROE	1
	SALMON SILVER, DRY	5.97
	SALMON SOCKEYE DRY	3.89
	SALMON SOCKEYE, CND SOLIDS AND LIQUID	1
	SALMON SOCKEYED KIPPERED	1.18
	SALMON SPREAD	0.38
	SALMON, BROILED OR BAKED	1.28
	SALMON, CHUM, COOKED	1.11
	SALMON, CHUM, FLESH, RAW	1
	SALMON, COHO, COOKED	1.11
	SALMON, KING, COOKED	0.99
	SALMON, KING, RAW	1
	SALMON, PINK, CND, SOL+LIQ, W/SALT	1
	SALMON, PINK, CND, SOL+LIQ, WO/SALT	1
	SALMON, PINK, COOKED	1.1
	SALMON, SMOKED	3.10
	SALMON, SOCKEYE, COOKED, DRY HEAT	1.13
	SALMON,CHUM DRY	3.84

Resource Code	Food Name	Wet Weight Conversion
120000000	**Non-Salmon Fish**	
	AKUTAG, FISH W SHORTENING	0.48
	BLACKFISH WHOLE	1
	COD, BROILED	1.28
	COD, CND	1.28
	DEVILFISH FLESH	1.27
	FISH, CHEE	1.28
	FLOUNDER, FLESH, AIR-DRIED	8.24
	GRAYLING FLESH	1.28
	HALIBUT, BROILED	1.28
	HALIBUT, SMOKED	3.10
	HERRING AIR-DRIED FLESH	1.91
	HERRING EGGS ON KELP, GIANT KELP	0.85
	HERRING EGGS PLAIN REMOVED FROM HEMLOCK BRANCHES	1
	HERRING ROE	1
	HERRING, PLAIN, CND, SOL+LIQ	1
	HERRING, SMOKED, KIPPERED	1.31
	LING COD FLESH	1
	LING COD LIVER	1
	PIKE AIR-DRIED FLESH	3.36
	PIKE FLESH	1.28
	SMELT FLESH AND SMALL BONES	1
	SMELT, CND, SOL+LIQ	1
	SMELT, RAINBOW, DRY FLESH	4.21
	TOM COD FLESH	1
	TOM COD LIVER	1.27
	TOM COD, DRY FLESH	2.91
	TROUT DOLLY VARDEN FLESH	1.28
	WHITEFISH FLESH, C. NASUS	1.28
	WHITEFISH LIVER	1.28
	WHITEFISH, DRY FLESH	4.85

Resource Code	Food Name	Wet Weight Conversion
210000000	**Large Land Mammals**	
	AGUTUK, MEAT	0.73
	AKUTAG, MEAT	0.73
	BEAR BLACK FLESH	1.42
	CARIBOU BONE MARROW	1.42
	CARIBOU LIVER	1.42
	CARIBOU STEW/SOUP	0.14
	CARIBOU TONGUE	1.42
	CARIBOU, RAW	1
	MOOSE FAT	1
	MOOSE FLESH	1.42
	MOOSE LIVER	1.42
	MOOSE NOSE	1
	MOOSE STEW	0.23
	MOOSE, DRY FLESH	1.65
	VENISON SITKA DEER	1.42
	VENISON, LEAN MEAT ONLY, RAW	1
220000000	**Small Land Mammals**	
	BEAVER FLESH	1.66
	MUSKRAT	1.66
	RABBIT, DOMESTICATED, FLESH ONLY, STEWED	1.66
230000000	**Feral Animals**	
	REINDEER MEAT	1.42
	REINDEER STEW	0.14

Resource Code	Food Name	Wet Weight Conversion
300000000	**Marine Mammals**	
	BELUGA MUKTUK(SKIN & FAT)	1
	BLUBBER, SEAL	1
	OOGRUK AIR-DRIED FLESH	6
	OOGRUK FLESH	1
	SEAL OIL	1
	SEAL RINGED FLESH	1.42
	SEAL, MEAT, DRY	1.64
	WALRUS FLESH	1.42
	WALRUS LIVER	1.42
	WALRUS, DRY FLESH	1.68
	WHALE BLUBBER SUBQ FAT	1
	WHALE, MUKTUK (SKIN+SUBCUT FAT)	1

Resource Code	Food Name	Wet Weight Conversion
410000000	**Migratory Birds**	
	DUCK, MEAT ONLY, ROASTED	1.35
	DUCK, MEAT&SKIN, ROASTED	1.54
	EIDERDUCK	1.37
	GOOSE CANADIAN FLESH	1.35
420000000	**Non-Migratory Birds**	
	PTARMIGAN BREAST MUSCLE	1.37
430000000	**Bird Eggs**	
	EGGS, DUCK, WHOLE, RAW	1
	EGGS, GOOSE, WHOLE, RAW	1

Resource Code	Food Name	Wet Weight Conversion
500000000	**Marine Invertebrates**	
	CLAMS, CND, DRAINED SOLIDS	1.29
	CLAMS, CND, SOL+LIQ	1
	CRAB, CND	1
	CRAB, STEAMED	1.28
	OYSTERS, CND	1
	OYSTERS, FRIED	1.67
	OYSTERS, FRZ	1
	SCALLOPS, FRZ, FRIED, REHEATED	1.67
	SHRIMP, CND, WET PK, SOL+LIQ	1
	SHRIMP, DRY PACK OR SOLIDS OF WET PACK	1.28
	SHRIMP, FRENCH-FRIED	1.14

Resource Code	Food Name	Wet Weight Conversion
600000000	**Vegetation**	
	BUTTERCUP YOUNG LEAVES, CHOPPED	1
	MUSHROOMS, CKD, WO/SALT	0.45
	MUSHROOMS, COMMON, RAW	1
	RHUBARB, FRZ, CKD, W/SUGAR	0.51
	RHUBARB, RAW	1
	SEAWEED DRIED BLACK	8.91
	SOURDOCK YOUNG LEAVES	1
	SPINACH, CKD W/SALT	0.31
	SPINACH, CKD WO/SALT	0.31
	SPINACH, FRZ, CHOPPED, CKD W/SALT	0.27
	SPINACH, FRZ, CHOPPED, CKD WO/SALT	0.27
	TEA, TUNDRA	0.004
601000000	**Berries**	
	AGUTUK, FISH/BERRY W SHORTENING	0.42
	AGUTUK, FRUIT W SHORTENING	0.60
	AKUTAG, FRUIT W SHORTENING	0.60
	BLACKBERRIES, RAW	1
	BLUEBERRIES, CND, HEAVY SIRUP	0.57
	BLUEBERRIES, FRZ, SWEETENED	0.63
	BLUEBERRIES, FRZ, UNSW	0.94
	BLUEBERRIES, RAW	1
	CURRANTS, EUROPEAN BLACK, RAW	1
	HIGH BUSH CRANBERRIES	1
	HUCKLEBERRY	1
	MOSSBERRIES	1
	RASPBERRIES, FRZ, RED, SWEETENED	0.49
	RASPBERRIES, RAW	1
	SALMONBERRY, RUBUS SPECTABILIS (S.EAST)	1
	STRAWBERRIES, CND, HEAVY SIRUP	0.59
	STRAWBERRIES, FRZ, SWEETENED, SLICED	0.59
	STRAWBERRIES, FRZ, SWEETENED, WHOLE	0.59
	STRAWBERRIES, FRZ, UNSW	1
	STRAWBERRIES, RAW	1

Appendix K: Comparison of per capita consumption (lbs/yr) and per capita harvest (lbs/yr) by community and major resource category

Note: Harvest information not available for all communities where consumption data were gathered. In these cases, the consumption data are provided without corresponding harvest data.

Community	Resource Code	Resource	Consumption (lbs/yr)	Harvest (lbs/yr)
"A"	110000000	Salmon	20.12	38.50
"A"	120000000	Non-Salmon	15.11	43.98
"A"	210000000	Lg Land Mammals	8.49	39.03
"A"	220000000	Sm Land Mammals	0.00	0.00
"A"	230000000	Feral Animals	0.37	
"A"	300000000	Marine Mammals	0.04	0.76
"A"	410000000	Migratory Birds	0.00	0.89
"A"	420000000	Non-Migratory Birds	0.00	0.01
"A"	430000000	Bird Eggs	0.00	0.00
"A"	500000000	Marine Invertebrates	21.62	19.10
"A"	600000000	Vegetation	8.38	4.05
"A"	601000000	Berries	7.09	2.84
"B"	110000000	Salmon	13.62	
"B"	120000000	Non-Salmon	21.12	
"B"	210000000	Lg Land Mammals	15.48	
"B"	220000000	Sm Land Mammals	0.00	
"B"	230000000	Feral Animals	3.63	
"B"	300000000	Marine Mammals	16.62	
"B"	410000000	Migratory Birds	1.71	
"B"	420000000	Non-Migratory Birds	0.00	
"B"	430000000	Bird Eggs	0.00	
"B"	500000000	Marine Invertebrates	0.35	
"B"	600000000	Vegetation	1.34	
"B"	601000000	Berries	1.12	
"C"	110000000	Salmon	57.07	94.96
"C"	120000000	Non-Salmon	31.05	15.54
"C"	210000000	Lg Land Mammals	73.00	237.54
"C"	220000000	Sm Land Mammals	0.00	2.23
"C"	230000000	Feral Animals	0.00	
"C"	300000000	Marine Mammals	2.61	4.58
"C"	410000000	Migratory Birds	14.49	13.16
"C"	420000000	Non-Migratory Birds	0.00	1.53
"C"	430000000	Bird Eggs	0.00	2.31
"C"	500000000	Marine Invertebrates	2.76	6.21
"C"	600000000	Vegetation	11.56	5.64
"C"	601000000	Berries	11.56	5.51
"D"	110000000	Salmon	154.83	720.99
"D"	120000000	Non-Salmon	9.07	69.38
"D"	210000000	Lg Land Mammals	39.54	49.40
"D"	220000000	Sm Land Mammals	5.14	4.82
"D"	230000000	Feral Animals	0.00	
"D"	300000000	Marine Mammals	0.00	0.00
"D"	410000000	Migratory Birds	0.00	2.98
"D"	420000000	Non-Migratory Birds	0.00	0.60
"D"	430000000	Bird Eggs	5.86	1.04
"D"	500000000	Marine Invertebrates	3.83	3.45
"D"	600000000	Vegetation	35.88	12.43
"D"	601000000	Berries	35.55	12.09

Community	Resource Code	Resource	Consumption (lbs/yr)	Harvest (lbs/yr)
"E"	110000000	Salmon	151.38	
"E"	120000000	Non-Salmon	194.55	
"E"	210000000	Lg Land Mammals	1.16	
"E"	220000000	Sm Land Mammals	1.09	
"E"	230000000	Feral Animals	2.90	
"E"	300000000	Marine Mammals	61.06	
"E"	410000000	Migratory Birds	33.76	
"E"	420000000	Non-Migratory Birds	9.89	
"E"	430000000	Bird Eggs	0.00	
"E"	500000000	Marine Invertebrates	0.88	
"E"	600000000	Vegetation	74.49	
"E"	601000000	Berries	69.00	
"F"	110000000	Salmon	70.97	141.40
"F"	120000000	Non-Salmon	11.21	17.46
"F"	210000000	Lg Land Mammals	44.28	57.74
"F"	220000000	Sm Land Mammals	1.01	8.14
"F"	230000000	Feral Animals	0.00	
"F"	300000000	Marine Mammals	9.38	2.97
"F"	410000000	Migratory Birds	0.71	2.51
"F"	420000000	Non-Migratory Birds	1.61	2.77
"F"	430000000	Bird Eggs	1.56	0.01
"F"	500000000	Marine Invertebrates	3.71	1.22
"F"	600000000	Vegetation	23.78	8.00
"F"	601000000	Berries	23.78	8.00
"G"	110000000	Salmon	44.91	
"G"	120000000	Non-Salmon	2.14	
"G"	210000000	Lg Land Mammals	10.86	
"G"	220000000	Sm Land Mammals	0.00	
"G"	230000000	Feral Animals	0.00	
"G"	300000000	Marine Mammals	0.00	
"G"	410000000	Migratory Birds	2.71	
"G"	420000000	Non-Migratory Birds	0.00	
"G"	430000000	Bird Eggs	0.00	
"G"	500000000	Marine Invertebrates	5.32	
"G"	600000000	Vegetation	2.46	
"G"	601000000	Berries	1.33	
"H"	110000000	Salmon	50.23	52.11
"H"	120000000	Non-Salmon	38.94	39.90
"H"	210000000	Lg Land Mammals	24.55	32.89
"H"	220000000	Sm Land Mammals	0.00	0.00
"H"	230000000	Feral Animals	0.00	
"H"	300000000	Marine Mammals	1.48	25.10
"H"	410000000	Migratory Birds	0.00	0.72
"H"	420000000	Non-Migratory Birds	0.00	0.18
"H"	430000000	Bird Eggs	0.00	0.00
"H"	500000000	Marine Invertebrates	3.61	16.87
"H"	600000000	Vegetation	16.42	20.28
"H"	601000000	Berries	8.10	6.34

Community	Resource Code	Resource	Consumption (lbs/yr)	Harvest (lbs/yr)
"J"	110000000	Salmon	325.40	254.21
"J"	120000000	Non-Salmon	147.22	396.65
"J"	210000000	Lg Land Mammals	52.37	77.15
"J"	220000000	Sm Land Mammals	18.12	51.22
"J"	230000000	Feral Animals	0.00	
"J"	300000000	Marine Mammals	40.65	22.76
"J"	410000000	Migratory Birds	13.66	12.98
"J"	420000000	Non-Migratory Birds	4.17	
"J"	430000000	Bird Eggs	0.00	
"J"	500000000	Marine Invertebrates	0.00	
"J"	600000000	Vegetation	18.79	
"J"	601000000	Berries	17.84	
"K"	110000000	Salmon	154.29	
"K"	120000000	Non-Salmon	63.39	
"K"	210000000	Lg Land Mammals	24.36	
"K"	220000000	Sm Land Mammals	0.70	
"K"	230000000	Feral Animals	9.58	
"K"	300000000	Marine Mammals	9.73	
"K"	410000000	Migratory Birds	8.52	
"K"	420000000	Non-Migratory Birds	9.22	
"K"	430000000	Bird Eggs	1.11	
"K"	500000000	Marine Invertebrates	2.57	
"K"	600000000	Vegetation	22.02	
"K"	601000000	Berries	21.78	
"L"	110000000	Salmon	12.80	
"L"	120000000	Non-Salmon	60.28	
"L"	210000000	Lg Land Mammals	48.94	
"L"	220000000	Sm Land Mammals	0.00	
"L"	230000000	Feral Animals	3.14	
"L"	300000000	Marine Mammals	21.82	6.75
"L"	410000000	Migratory Birds	5.01	0.60
"L"	420000000	Non-Migratory Birds	0.00	0.00
"L"	430000000	Bird Eggs	0.00	
"L"	500000000	Marine Invertebrates	0.37	
"L"	600000000	Vegetation	5.66	
"L"	601000000	Berries	4.81	

Table 28: Per Capita Consumption of Top Five Resources by Community

Community	Five Most Consumed Resources (estimated annual per capita consumption)									
	Resource	*lbs.*	*Resource*	*lbs.*	*Resource*	*lbs.*	*Resource*	*lbs.*	*Resource*	*lbs.*
A	Marine Invertebrates	22	Salmon	20	Non-Salmon Fish	15	Large Land Mammals	8	Plants and Berries	8
B*	Non-Salmon Fish	21	Marine Mammals	17	Large Land Mammals	15	Salmon	14	Feral Animals	4
C**	Large Land Mammals	73	Salmon	57	Non-Salmon Fish	31	Migratory Birds	14	Plants and Berries	12
D	Salmon	155	Large Land Mammals	40	Plants and Berries	36	Non-Salmon Fish	9	Bird Eggs	6
E	Non-Salmon Fish	195	Salmon	151	Plants and Berries	74	Marine Mammals	61	Migratory Birds	34
F	Salmon	71	Large Land Mammals	44	Plants and Berries	24	Non-Salmon Fish	11	Marine Mammals	9
G	Salmon	45	Large Land Mammals	11	Marine Invertebrates	5	Migratory Birds	3	Non-Salmon Fish	2
H	Salmon	50	Non-Salmon Fish	39	Large Land Mammals	25	Plants and Berries	16	Marine Invertebrates	4
J	Salmon	325	Non-Salmon Fish	147	Large Land Mammals	52	Marine Mammals	41	Small Land Mammals	18
K	Salmon	154	Non-Salmon Fish	63	Large Land Mammals	24	Plants and Berries	22	Marine Mammals	10
L	Non-Salmon Fish	60	Large Land Mammals	49	Marine Mammals	22	Salmon	13	Migratory Birds	5

* The low number of subjects in summer and fall may result in non-representative estimates of intakes.

** The low number of subjects in summer may result in non-representative estimates of intakes.

*** Includes resources not in top five consumed; therefore rows do not sum to displayed total.

Appendix L: Graphical comparison of annual consumption and harvest rates

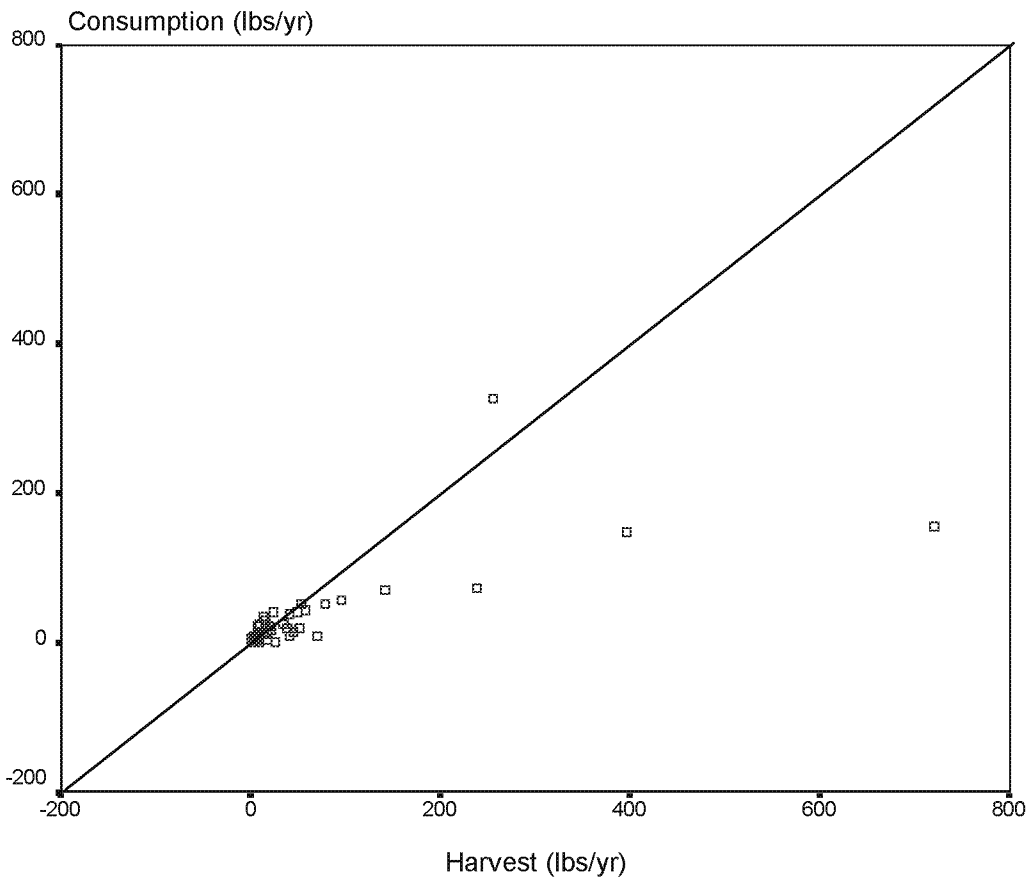


Figure 7: Comparison of annual consumption rates to annual harvest rates among all communities for all major resource categories where information was available.

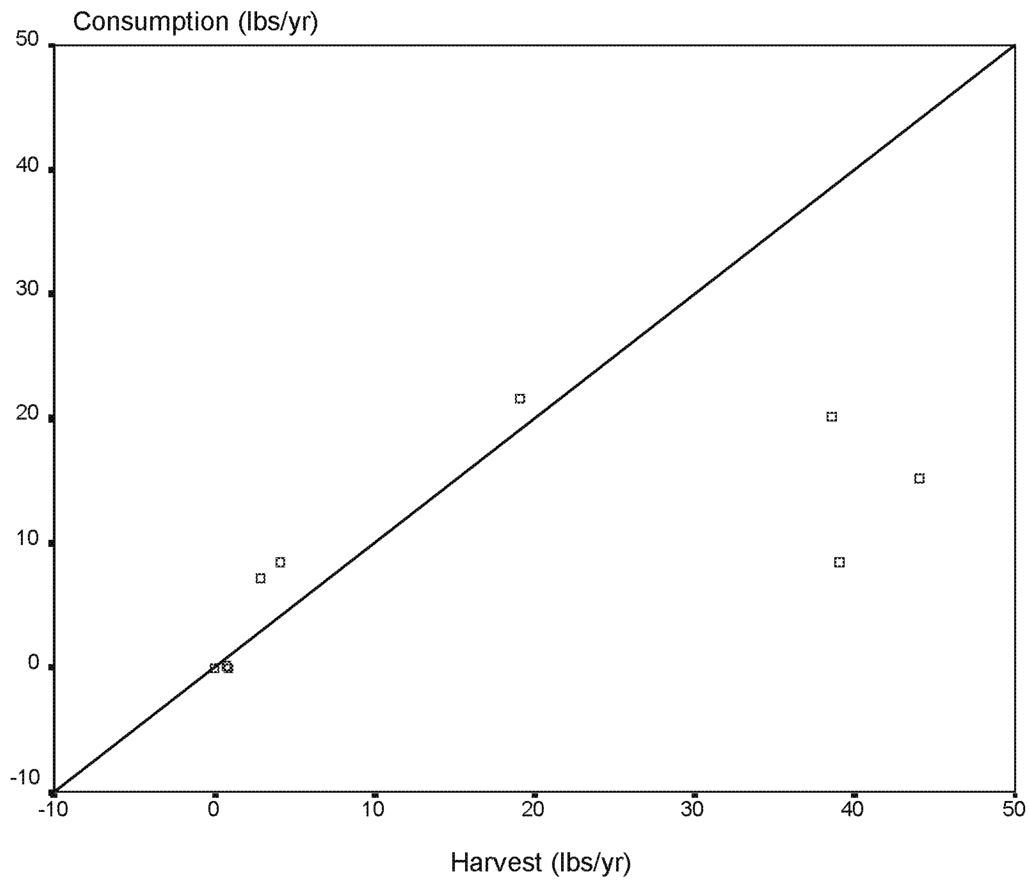


Figure 8: Comparison of annual consumption rates to annual harvest rates for all major resource categories - Community "A".

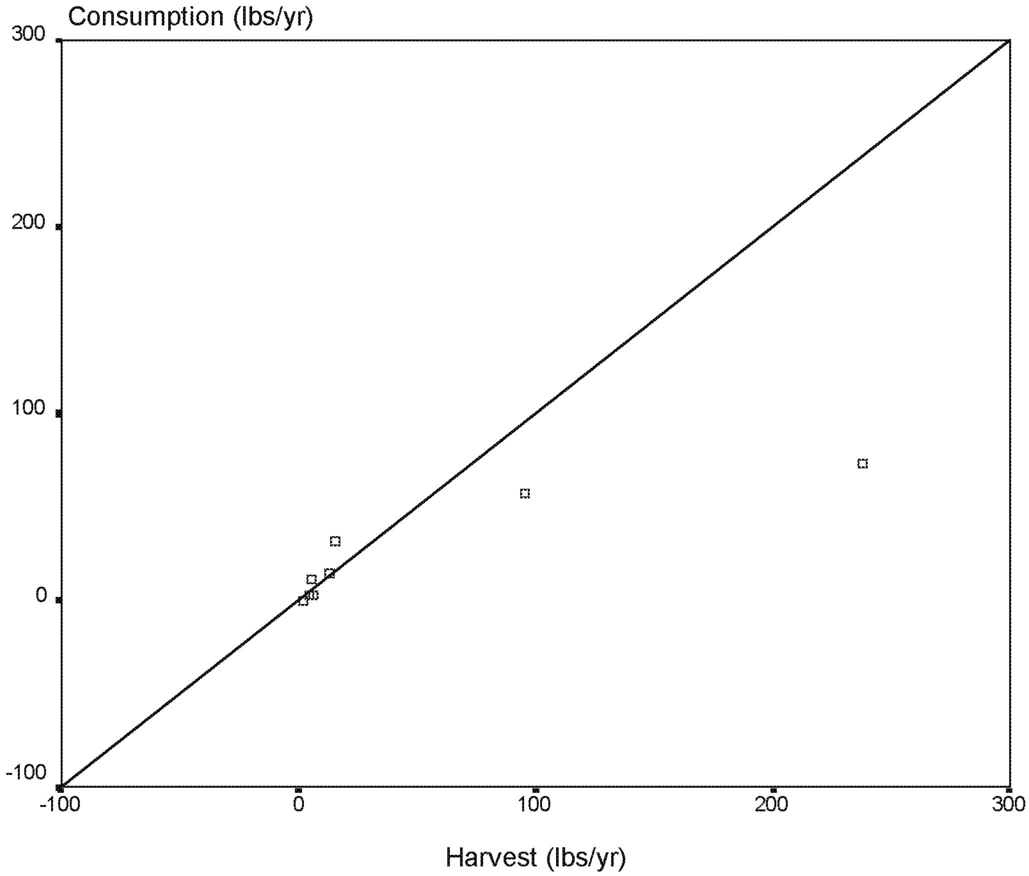


Figure 9: Comparison of annual consumption rates to annual harvest rates for all major resource categories - Community "C".

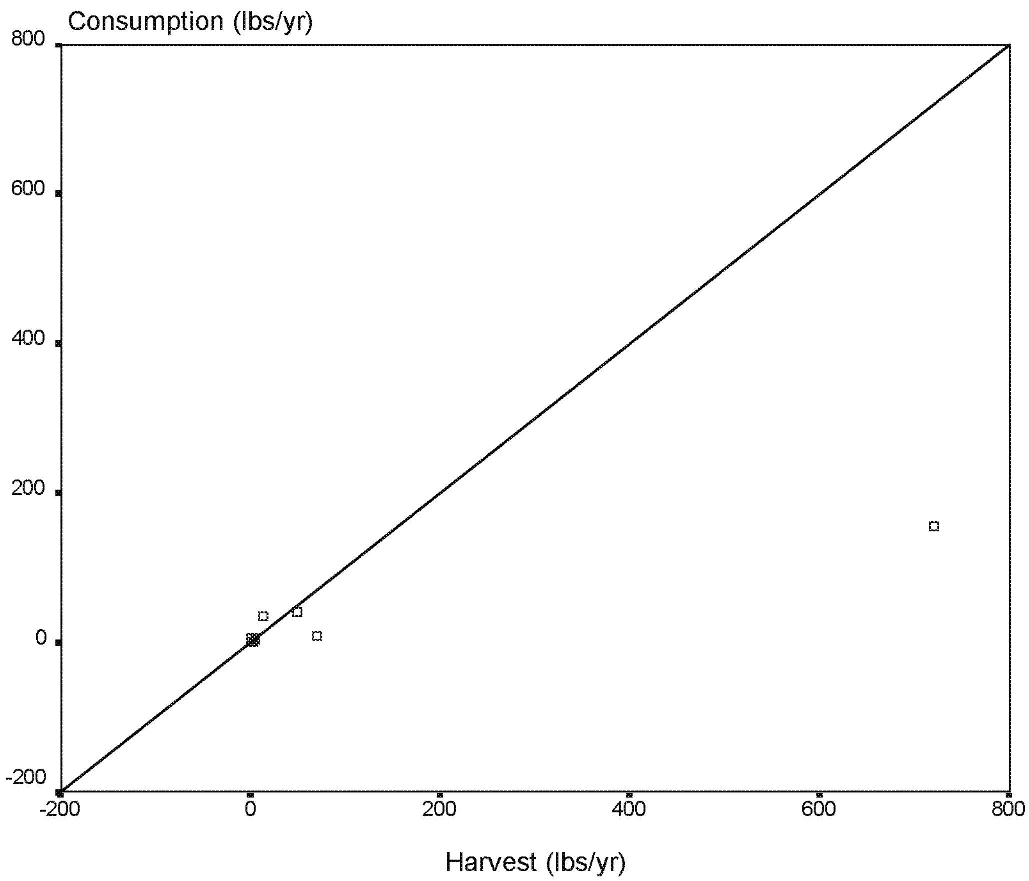


Figure 10: Comparison of annual consumption rates to annual harvest rates for all major resource categories - Community “D”.

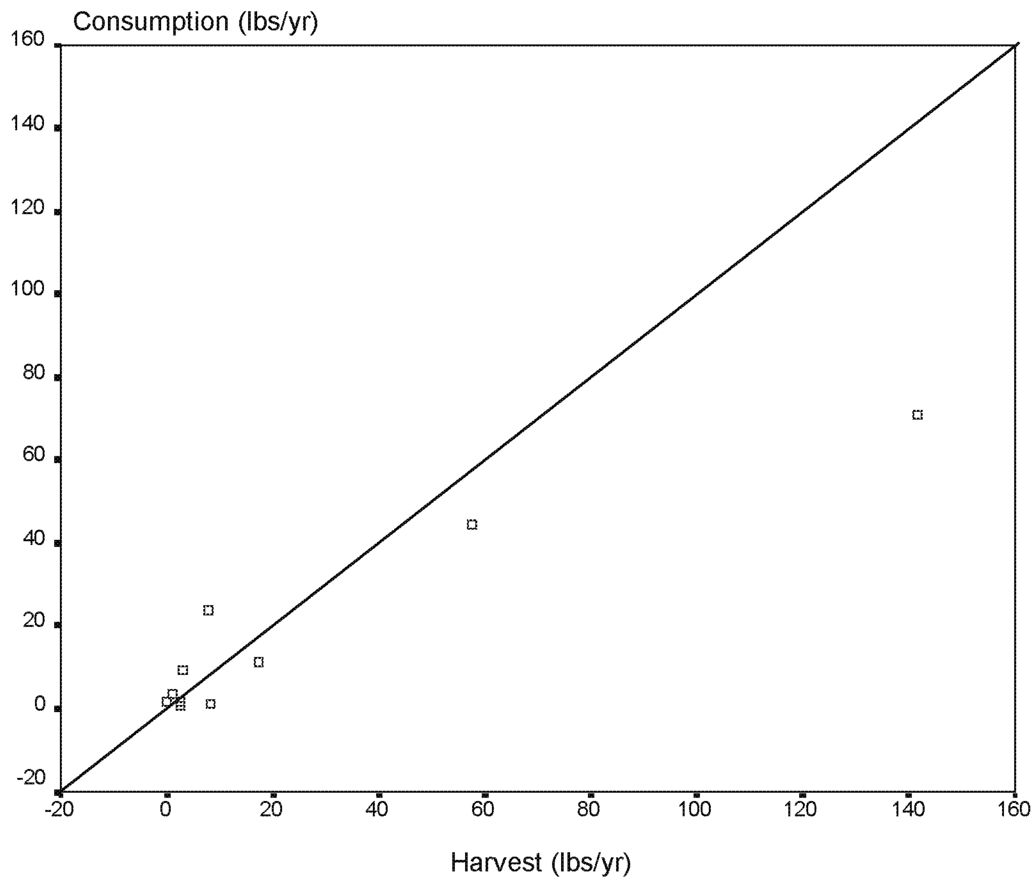


Figure 11: Comparison of annual consumption rates to annual harvest rates for all major resource categories - Community “F”.

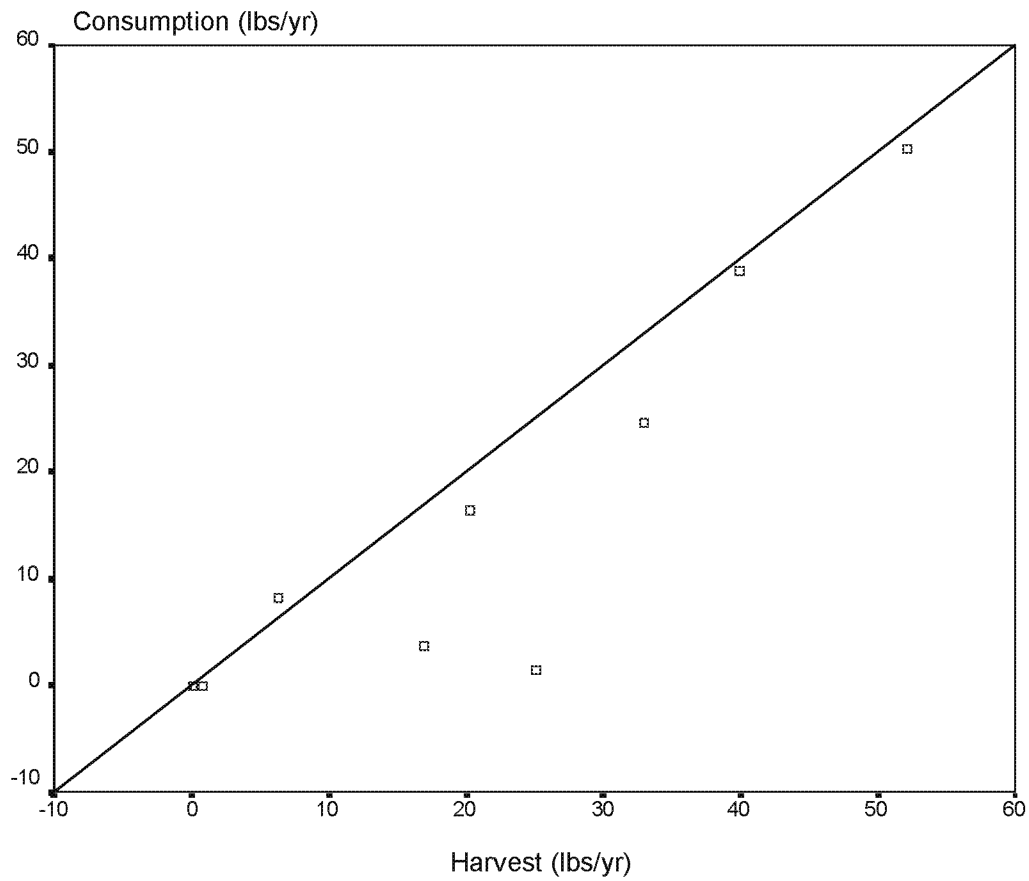


Figure 12: Comparison of annual consumption rates to annual harvest rates for all major resource categories - Community "H".

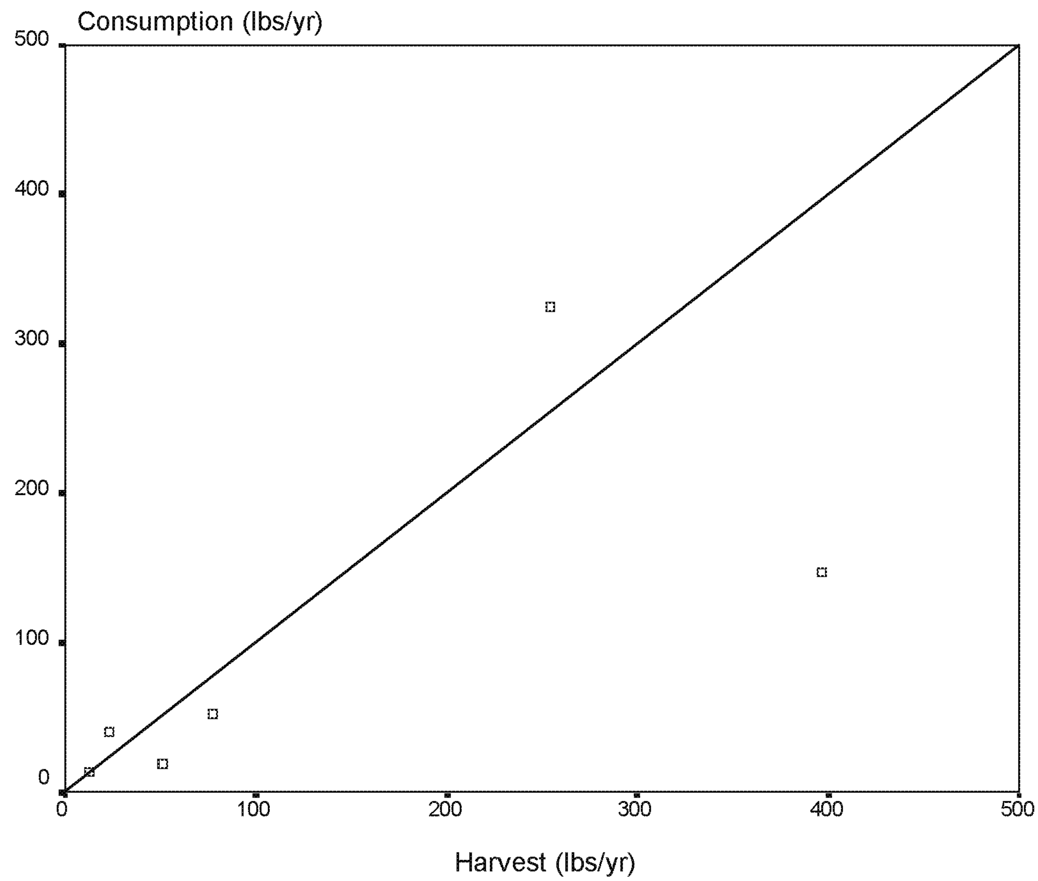


Figure 13: Comparison of annual consumption rates to annual harvest rates for all major resource categories - Community “J”.

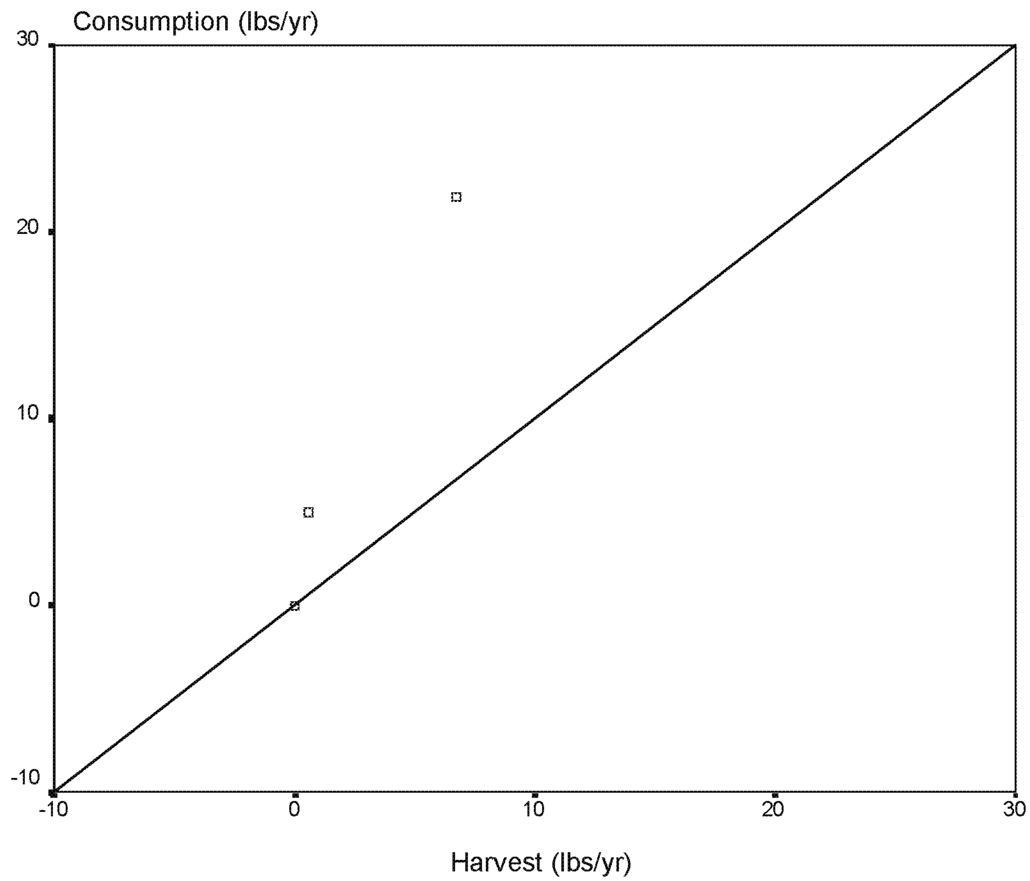


Figure 14: Comparison of annual consumption rates to annual harvest rates for all major resource categories - Community "L".

Appendix M: Seasonal per capita consumption histograms

Note: Only ten of eleven communities had consumption information available in all four seasons; seasonal consumption histograms are presented below for these ten communities. In some cases, consumption information was available in two summer seasons for the same communities. In these cases, the summer consumption rates were averaged and presented along with the other seasonal consumption information.

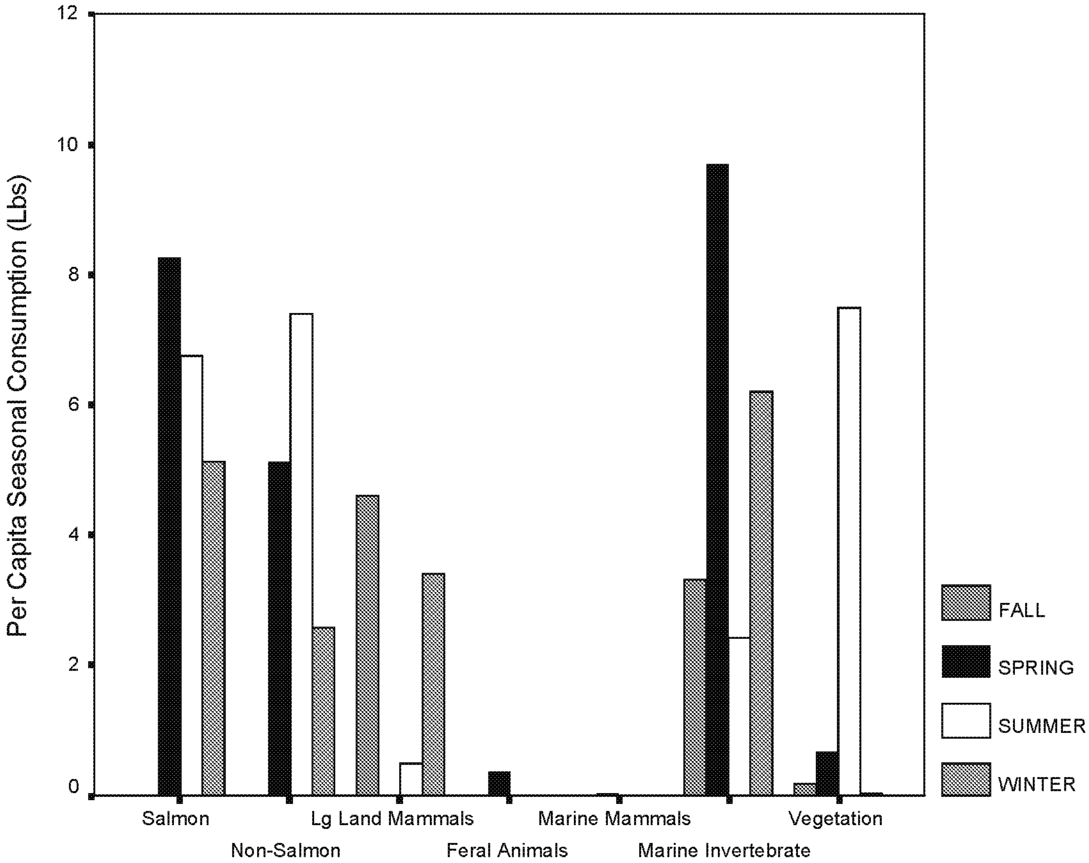


Figure 15: Seasonal consumption (Lbs) of major resources in Community "A", 1987-88

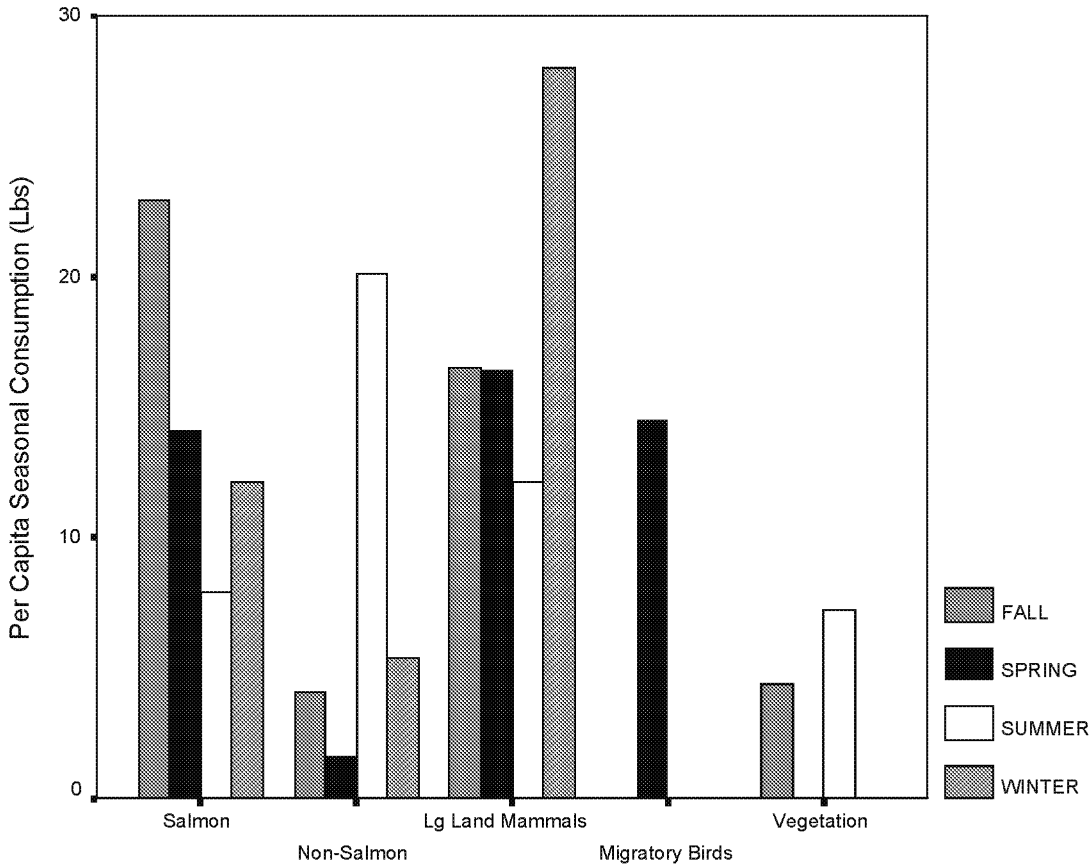


Figure 16: Seasonal consumption (Lbs) of major resources in Community "C", 1987-88

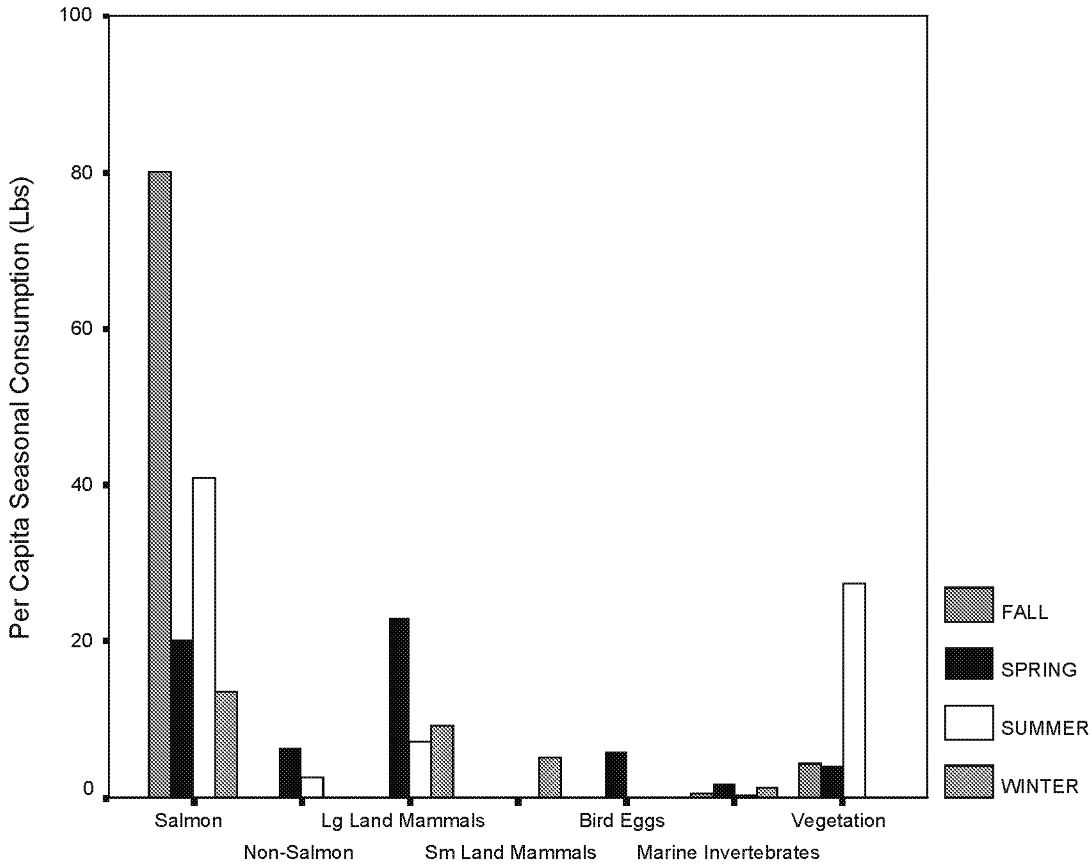


Figure 17: Seasonal consumption (Lbs) of major resources in Community “D”, 1987-88

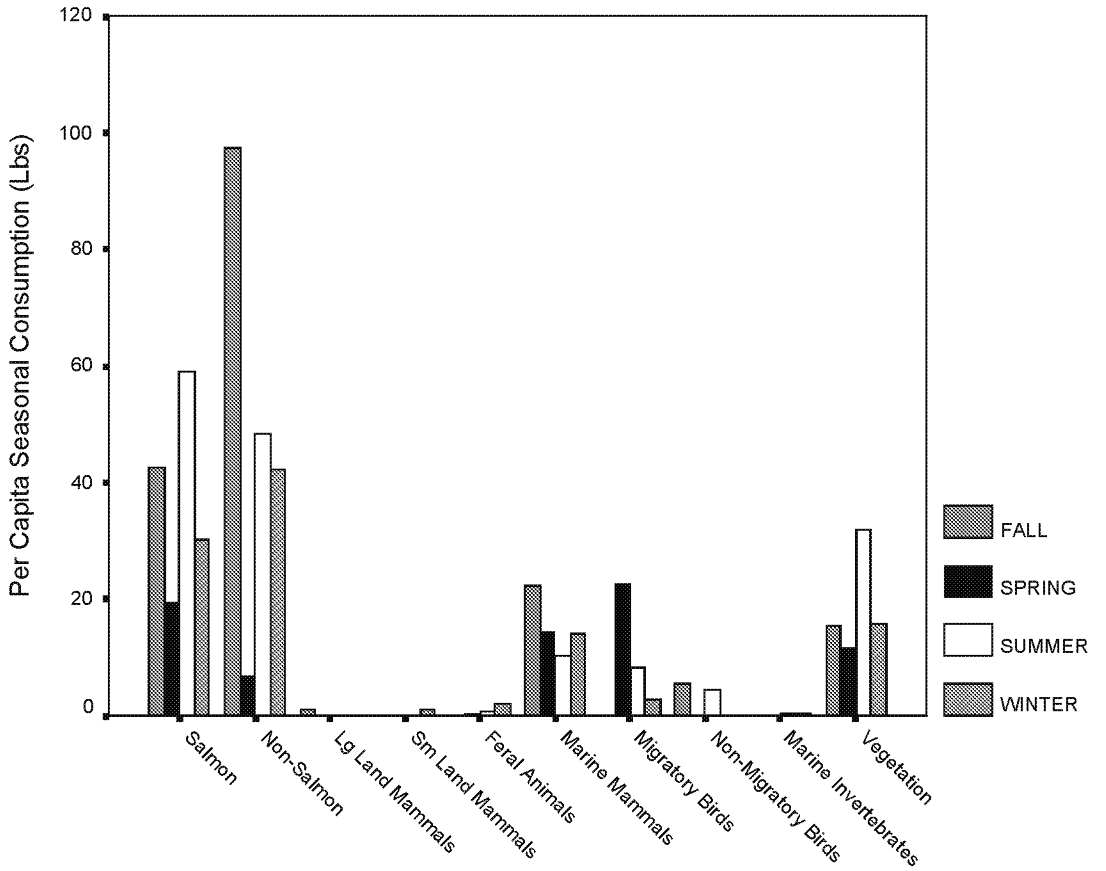


Figure 18: Seasonal consumption (Lbs) of major resources in Community "E", 1987-88

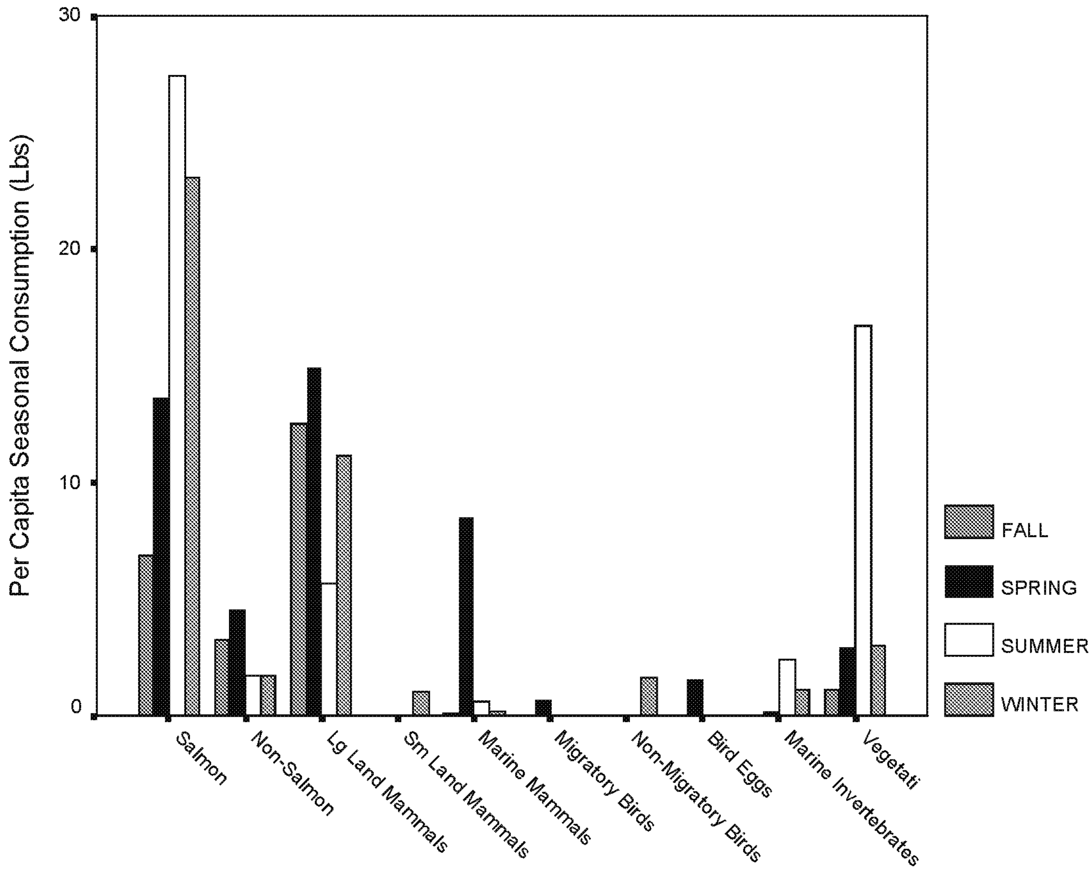


Figure 19: Seasonal consumption (Lbs) of major resources in Community “F”, 1987-88

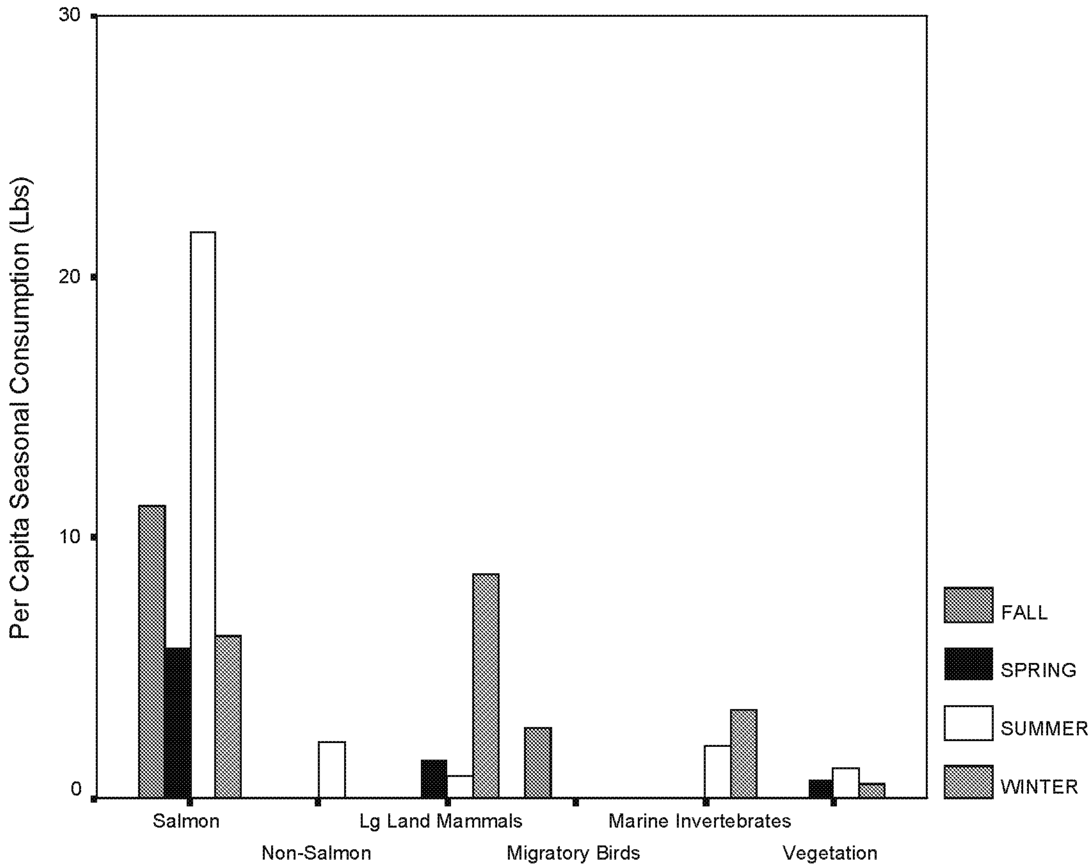


Figure 20: Seasonal consumption (Lbs) of major resources in Community "G", 1987-88

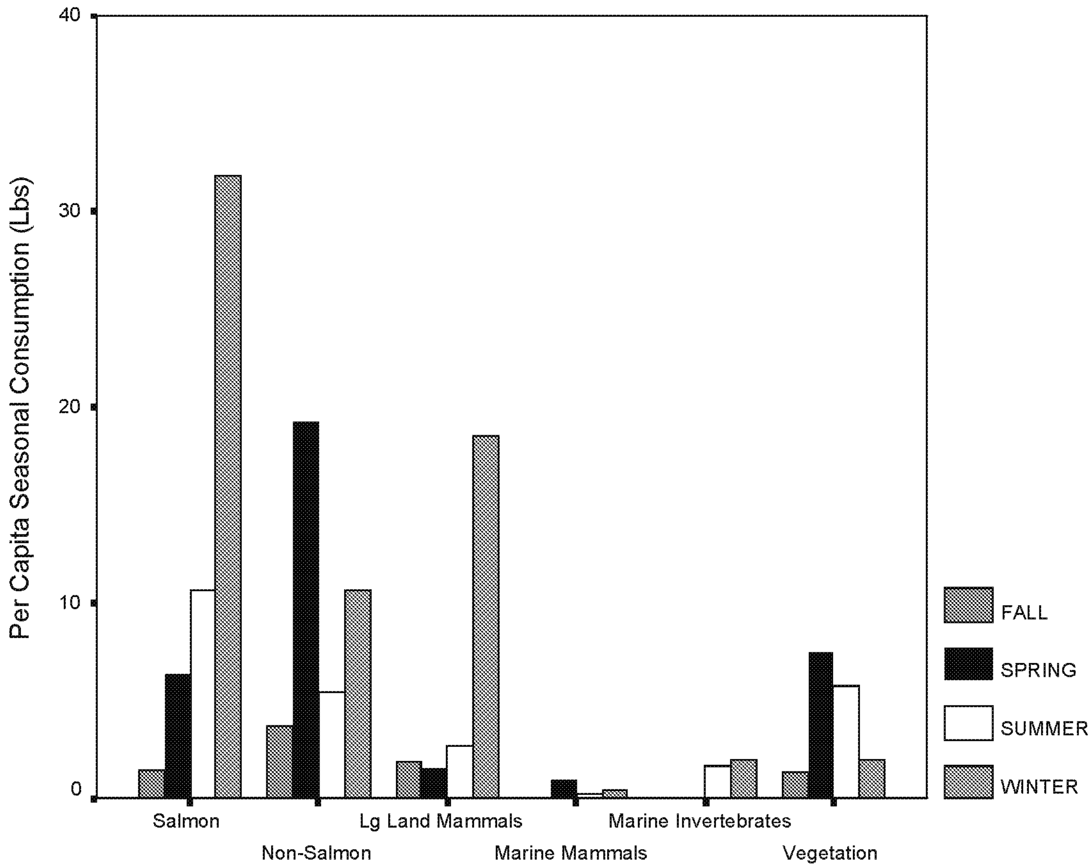


Figure 21: Seasonal consumption (Lbs) of major resources in Community "H", 1987-88

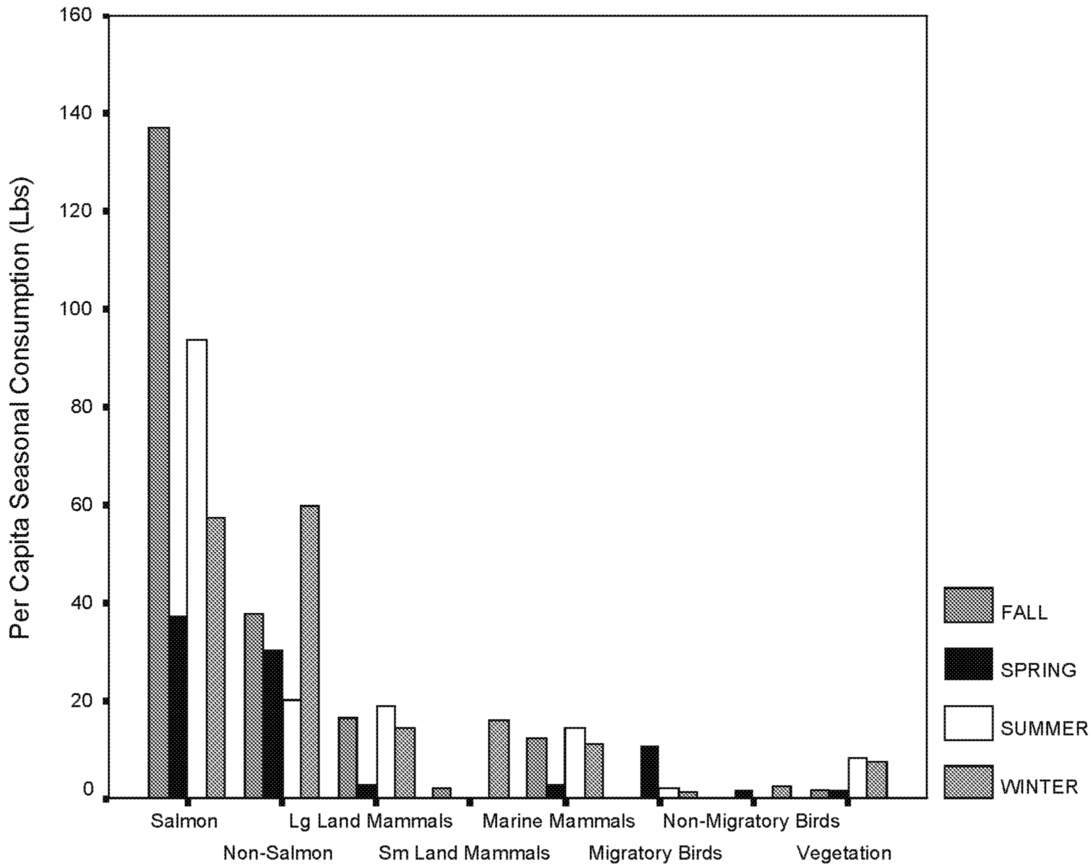


Figure 22: Seasonal consumption (Lbs) of major resources in Community “J”, 1987-88

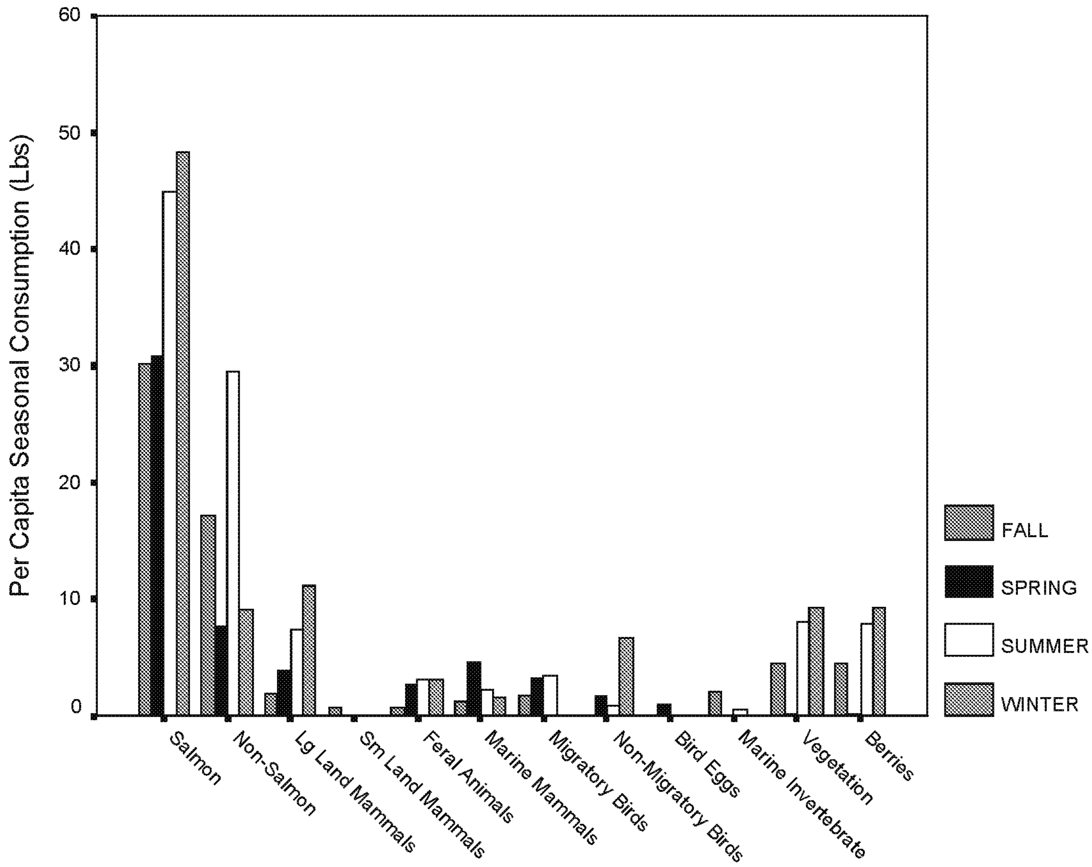


Figure 23: Seasonal consumption (Lbs) of major resources in Community "K", 1987-88

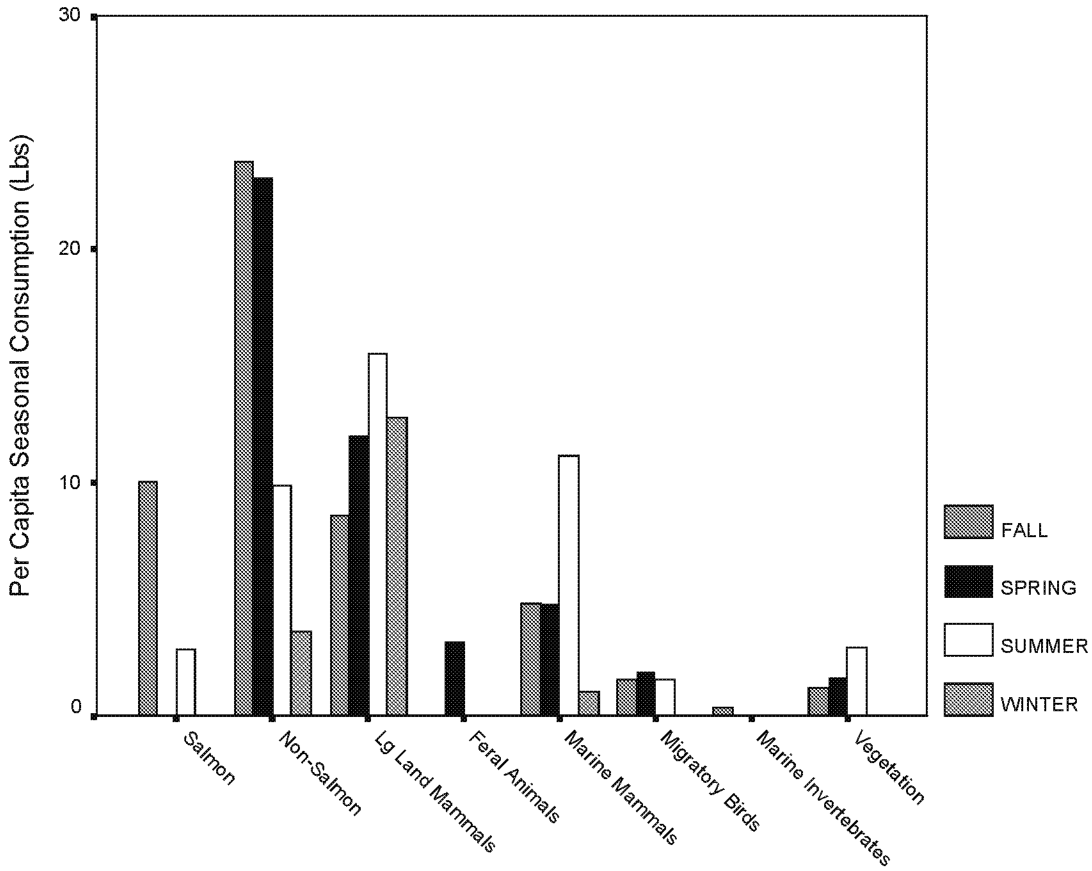


Figure 24: Seasonal consumption (Lbs) of major resources in Community "L", 1987-88

Appendix N: Per capita seasonal and annual consumption rates (mean ± standard error) by resource and community (lbs)

Community	Resource	Winter*	Spring*	Fall*	Summer*	Annual*
"A"	Salmon	5.11 ± 11.41	8.26 ± 18.43		6.74 ± 15.05	20.12 ± 26.39
"A"	Non-Salmon	2.59 ± 5.79	5.12 ± 11.42		7.40 ± 16.52	15.11 ± 20.90
"A"	Lg Land Mammals	3.41 ± 7.60		4.60 ± 10.26	0.49 ± 1.09	8.49 ± 12.82
"A"	Sm Land Mammals					
"A"	Feral Animals		0.37 ± 0.84			0.37 ± 0.84
"A"	Marine Mammals		0.04 ± 0.08			0.04 ± 0.08
"A"	Migratory Birds					
"A"	Non-Migratory Birds					
"A"	Bird Eggs					
"A"	Marine Invertebrates	6.19 ± 13.81	9.71 ± 21.66	3.30 ± 7.37	2.43 ± 5.42	21.62 ± 27.27
"A"	Vegetation	0.04 ± 0.08	0.68 ± 1.11	0.18 ± 0.39	7.49 ± 15.39	8.38 ± 15.44
"A"	Berries		0.22 ± 0.49		6.87 ± 15.33	7.09 ± 15.34
"B"	Salmon		3.39 ± 7.56		10.23 ± 22.84	13.62 ± 24.05
"B"	Non-Salmon	13.09 ± 29.21	3.77 ± 8.41		4.26 ± 9.51	21.12 ± 31.85
"B"	Lg Land Mammals	6.38 ± 14.25	6.15 ± 13.72		2.95 ± 6.59	15.48 ± 20.85
"B"	Sm Land Mammals					
"B"	Feral Animals				3.63 ± 8.10	3.63 ± 8.10
"B"	Marine Mammals	1.20 ± 2.69	15.42 ± 34.41			16.62 ± 34.51
"B"	Migratory Birds		1.71 ± 3.81			1.71 ± 3.81
"B"	Non-Migratory Birds					
"B"	Bird Eggs					
"B"	Marine Invertebrates		0.35 ± 0.77			0.35 ± 0.77
"B"	Vegetation		1.12 ± 2.49		0.22 ± 0.49	1.34 ± 2.49
"B"	Berries		1.12 ± 2.49			1.12 ± 2.49

* Data reported as mean ± standard error

Community	Resource	Winter*	Spring*	Fall*	Summer*	Annual*
"C"	Salmon	12.16 ± 27.14	14.09 ± 31.46	22.93 ± 51.18	7.88 ± 17.59	57.07 ± 68.23
"C"	Non-Salmon	5.34 ± 11.92	1.60 ± 3.58	4.03 ± 9.00	20.07 ± 44.80	31.05 ± 47.36
"C"	Lg Land Mammals	28.00 ± 62.50	16.38 ± 36.57	16.51 ± 36.84	12.10 ± 27.01	73.00 ± 85.62
"C"	Sm Land Mammals					
"C"	Feral Animals					
"C"	Marine Mammals			0.60 ± 1.34	2.01 ± 4.48	2.61 ± 4.68
"C"	Migratory Birds		14.49 ± 32.33			14.49 ± 32.33
"C"	Non-Migratory Birds					
"C"	Bird Eggs					
"C"	Marine Invertebrates	2.76 ± 6.17				2.76 ± 6.17
"C"	Vegetation			4.34 ± 9.68	7.23 ± 16.13	11.56 ± 18.81
"C"	Berries			4.34 ± 9.68	7.23 ± 16.13	11.56 ± 18.81
"D"	Salmon	13.65 ± 30.45	20.10 ± 44.85	80.14 ± 178.87	40.95 ± 91.39	154.83 ± 208.05
"D"	Non-Salmon		6.42 ± 14.34		2.64 ± 5.90	9.07 ± 15.50
"D"	Lg Land Mammals	9.27 ± 20.69	23.00 ± 51.34		7.27 ± 16.22	39.54 ± 57.68
"D"	Sm Land Mammals	5.14 ± 11.48				5.14 ± 11.48
"D"	Feral Animals					
"D"	Marine Mammals					
"D"	Migratory Birds					
"D"	Non-Migratory Birds					
"D"	Bird Eggs		5.86 ± 13.07			5.86 ± 13.07
"D"	Marine Invertebrates	1.22 ± 2.72	1.89 ± 4.23	0.52 ± 1.16	0.20 ± 0.44	3.83 ± 4.41
"D"	Vegetation		4.20 ± 8.79	4.34 ± 9.68	27.35 ± 60.89	35.88 ± 62.28
"D"	Berries		3.93 ± 8.77	4.34 ± 9.68	27.28 ± 60.89	35.55 ± 62.28

* Data reported as mean ± standard error

Community	Resource	Winter*	Spring*	Fall*	Summer*	Annual*
"E"	Salmon	30.22 ± 67.44	19.48 ± 43.48	42.54 ± 94.95	59.14 ± 131.99	151.38 ± 181.32
"E"	Non-Salmon	42.11 ± 93.98	6.74 ± 15.05	97.41 ± 217.41	48.29 ± 107.79	194.55 ± 260.66
"E"	Lg Land Mammals			1.16 ± 2.58		1.16 ± 2.58
"E"	Sm Land Mammals	1.09 ± 2.43				1.09 ± 2.43
"E"	Feral Animals	2.13 ± 4.75	0.26 ± 0.58		0.51 ± 1.15	2.90 ± 4.92
"E"	Marine Mammals	14.04 ± 31.33	14.42 ± 32.18	22.16 ± 49.47	10.44 ± 23.30	61.06 ± 70.76
"E"	Migratory Birds	2.82 ± 6.30	22.77 ± 50.83		8.17 ± 18.23	33.76 ± 34.37
"E"	Non-Migratory Birds			5.41 ± 12.08	4.47 ± 9.98	9.89 ± 15.67
"E"	Bird Eggs					
"E"	Marine Invertebrates	0.44 ± 0.98			0.44 ± 0.98	0.88 ± 1.39
"E"	Vegetation	15.73 ± 35.11	11.56 ± 25.81	15.42 ± 34.42	31.77 ± 59.932	74.49 ± 81.70
"E"	Berries	15.73 ± 35.11	11.56 ± 25.81	15.42 ± 34.42	26.28 ± 58.66	69.00 ± 80.77
"F"	Salmon	23.02 ± 51.38	13.67 ± 30.51	6.87 ± 15.32	27.42 ± 61.19	70.97 ± 86.88
"F"	Non-Salmon	1.69 ± 3.78	4.54 ± 10.13	3.29 ± 7.35	1.68 ± 3.75	11.21 ± 13.60
"F"	Lg Land Mammals	11.17 ± 24.93	14.87 ± 33.19	12.55 ± 28.00	5.69 ± 12.70	44.28 ± 51.66
"F"	Sm Land Mammals	1.01 ± 2.26				1.01 ± 2.26
"F"	Feral Animals					
"F"	Marine Mammals	0.21 ± 0.46	8.47 ± 18.89	0.12 ± 0.27	0.59 ± 1.32	9.38 ± 18.95
"F"	Migratory Birds		0.71 ± 1.58			0.71 ± 1.58
"F"	Non-Migratory Birds	1.61 ± 3.59				1.61 ± 3.59
"F"	Bird Eggs		1.56 ± 3.48			1.56 ± 3.48
"F"	Marine Invertebrates	1.12 ± 2.49	0.21 ± 0.47		2.38 ± 5.32	3.71 ± 5.89
"F"	Vegetation	3.00 ± 6.69	2.94 ± 6.57	1.16 ± 2.58	16.68 ± 37.23	23.78 ± 38.48
"F"	Berries	3.00 ± 6.69	2.94 ± 6.57	1.16 ± 2.58	16.68 ± 37.23	23.78 ± 38.48

* Data reported as mean ± standard error

Community	Resource	Winter*	Spring*	Fall*	Summer*	Annual*
"G"	Salmon	6.23 ± 13.91	5.79 ± 12.93	11.19 ± 24.97	21.70 ± 48.44	44.91 ± 57.71
"G"	Non-Salmon				2.14 ± 4.78	2.14 ± 4.78
"G"	Lg Land Mammals	8.58 ± 19.14	1.45 ± 3.23		0.84 ± 1.87	10.86 ± 19.50
"G"	Sm Land Mammals					
"G"	Feral Animals					
"G"	Marine Mammals					
"G"	Migratory Birds			2.71 ± 6.04		2.71 ± 6.04
"G"	Non-Migratory Birds					
"G"	Bird Eggs					
"G"	Marine Invertebrates	3.35 ± 7.48			1.97 ± 4.41	5.32 ± 8.68
"G"	Vegetation	0.56 ± 1.25	0.72 ± 1.14		1.18 ± 1.96	2.46 ± 2.59
"G"	Berries	0.56 ± 1.25	0.37 ± 0.82		0.40 ± 0.90	1.33 ± 1.74
"H"	Salmon	31.83 ± 71.05	6.37 ± 14.22	1.39 ± 3.10	10.63 ± 23.73	50.23 ± 76.30
"H"	Non-Salmon	10.65 ± 23.77	19.26 ± 43.00	3.64 ± 8.12	5.39 ± 12.02	38.94 ± 51.23
"H"	Lg Land Mammals	18.52 ± 41.34	1.54 ± 3.44	1.79 ± 4.00	2.69 ± 6.00	24.55 ± 42.11
"H"	Sm Land Mammals					
"H"	Feral Animals					
"H"	Marine Mammals	0.38 ± 0.85	0.93 ± 2.07		0.17 ± 0.37	1.48 ± 2.27
"H"	Migratory Birds					
"H"	Non-Migratory Birds					
"H"	Bird Eggs					
"H"	Marine Invertebrates	1.97 ± 4.40			1.64 ± 3.65	3.61 ± 5.72
"H"	Vegetation	1.96 ± 3.34	7.44 ± 11.76	1.33 ± 2.97	5.70 ± 5.44	16.42 ± 13.71
"H"	Berries	1.39 ± 3.09	3.45 ± 7.70		3.26 ± 7.28	8.10 ± 11.04

* Data reported as mean ± standard error

Community	Resource	Winter*	Spring*	Fall*	Summer*	Annual*
"J"	Salmon	57.46 ± 128.25	37.28 ± 83.20	137.10 ± 306.00	93.57 ± 208.83	325.40 ± 400.76
"J"	Non-Salmon	59.54 ± 132.89	30.10 ± 67.19	37.71 ± 84.17	19.87 ± 44.34	147.22 ± 176.70
"J"	Lg Land Mammals	14.36 ± 32.04	2.77 ± 6.18	16.48 ± 36.78	18.77 ± 41.88	52.37 ± 64.59
"J"	Sm Land Mammals	16.05 ± 35.82		2.07 ± 4.63		18.12 ± 36.11
"J"	Feral Animals					
"J"	Marine Mammals	11.15 ± 24.88	2.90 ± 6.48	12.09 ± 26.98	14.50 ± 32.37	40.65 ± 49.37
"J"	Migratory Birds	1.10 ± 2.45	10.55 ± 23.54		2.02 ± 4.51	13.66 ± 24.09
"J"	Non-Migratory Birds	2.50 ± 5.58	1.67 ± 3.72			4.17 ± 6.70
"J"	Bird Eggs					
"J"	Marine Invertebrates					
"J"	Vegetation	7.53 ± 16.37	1.44 ± 2.48	1.45 ± 3.23	8.38 ± 17.94	18.79 ± 24.62
"J"	Berries	7.33 ± 16.36	1.04 ± 2.32	1.45 ± 3.23	8.03 ± 17.92	17.84 ± 24.59
"K"	Salmon	48.35 ± 107.90	30.84 ± 68.83	30.17 ± 67.33	44.94 ± 100.30	154.29 ± 175.99
"K"	Non-Salmon	9.12 ± 20.35	7.65 ± 17.08	17.19 ± 38.38	29.42 ± 65.67	63.39 ± 80.57
"K"	Lg Land Mammals	11.08 ± 24.74	3.99 ± 8.91	1.92 ± 4.28	7.36 ± 16.44	24.36 ± 31.30
"K"	Sm Land Mammals			0.70 ± 1.57		0.70 ± 1.57
"K"	Feral Animals	3.17 ± 7.07	2.71 ± 6.06	0.62 ± 1.39	3.08 ± 6.87	9.58 ± 11.65
"K"	Marine Mammals	1.58 ± 3.52	4.63 ± 10.33	1.28 ± 2.86	2.24 ± 5.01	9.73 ± 12.34
"K"	Migratory Birds		3.24 ± 7.24	1.80 ± 4.01	3.48 ± 7.77	8.52 ± 11.35
"K"	Non-Migratory Birds	6.62 ± 14.77	1.80 ± 4.01		0.81 ± 1.81	9.22 ± 4.40
"K"	Bird Eggs		1.11 ± 2.48			1.11 ± 2.48
"K"	Marine Invertebrates			2.12 ± 4.73	0.46 ± 1.02	2.57 ± 4.83
"K"	Vegetation	9.24 ± 20.61	0.22 ± 0.50	4.45 ± 9.93	8.11 ± 17.59	22.02 ± 28.86
"K"	Berries	9.24 ± 20.61	0.22 ± 0.50	4.45 ± 9.93	7.88 ± 17.58	21.78 ± 28.56

* Data reported as mean ± standard error

Community	Resource	Winter*	Spring*	Fall*	Summer*	Annual*
"L"	Salmon			9.99 ± 22.30	2.81 ± 6.26	12.80 ± 23.16
"L"	Non-Salmon	3.64 ± 8.12	23.05 ± 51.44	23.77 ± 53.04	9.83 ± 21.94	60.28 ± 77.50
"L"	Lg Land Mammals	12.80 ± 28.57	12.04 ± 26.88	8.59 ± 19.17	15.51 ± 34.62	48.94 ± 55.72
"L"	Sm Land Mammals					
"L"	Feral Animals		3.14 ± 7.00			3.14 ± 7.00
"L"	Marine Mammals	1.05 ± 2.33	4.82 ± 10.75	4.82 ± 10.75	11.14 ± 24.87	21.82 ± 29.24
"L"	Migratory Birds		1.92 ± 4.28	1.52 ± 3.40	1.57 ± 3.51	5.01 ± 6.32
"L"	Non-Migratory Birds					
"L"	Bird Eggs					
"L"	Marine Invertebrates			0.37 ± 0.83		0.37 ± 0.83
"L"	Vegetation		1.61 ± 3.58	1.16 ± 2.02	2.89 ± 6.46	5.66 ± 7.66
"L"	Berries		1.61 ± 3.58	0.31 ± 0.70	2.89 ± 6.46	4.81 ± 7.42

* Data reported as mean ± standard error

Appendix O: Life history notes for major Alaska subsistence resources

RESOURCE	NOTES ON LIFE HISTORY
Salmon	Most salmon spawn in streams and rivers, spend several years of their life in ocean waters and return to their stream of origin for a few weeks to spawn and die. Harvesting occurs during their return migration.
Non-Salmon	This category includes land locked species that remain in the same fresh water location their entire lives. It also includes ocean fish such as halibut that may be bottom feeders. Some fish are short lived while others, such as halibut, live many years and attain weights of hundreds of pounds.
Large Land Mammals	Moose may browse vegetation in a relatively limited geographic area, whereas caribou that migrate thousands of miles browse in different locations and consume lichens and other plants in their summer and winter habitats. Bears consume a more varied diet of plants, roots, berries, grubs, and fish.
Small Land Mammals	Beaver, muskrat, and rabbit live in a relatively small geographic radius. Beaver and muskrat are exposed to aquatic environments as well as terrestrial environments
Feral Animals	The most predominant feral animal used for food among the dietary investigation participants is reindeer. Like caribou, reindeer feed on lichen and other browse plants found in tundra environments. Their range is more limited in contrast to caribou because reindeer are herded.
Marine Mammals	Seals, walrus, live in an ocean environment. Polar bears, high on the food chain, rely heavily on the ocean for food. Some species, such as bowhead whales, may migrate half a world away in winter, passing the Russian Far East and the North American Continent , returning to feed on plankton in northern waters in the summer. Other marine mammals consume animals, fish and invertebrates lower on the food chain.
Migratory Birds	Birds may migrate as far as South America, but they return to Alaska to breed and feed in the spring and summer. They feed in aquatic environments as well as terrestrial environments.
Non-migratory Birds	Ptarmigan and grouse remain in Alaska year round, consuming a plant based diet.
Bird eggs	Bird eggs are harvested in the spring or early summer months. The habitat and genetics of the birds that produce them will influence their content and size.
Marine invertebrates	Including mollusks and crustaceans remain in a limited geographic area in an aquatic environment. They are in contact with saltwater sediments and obtain their food from the water. Their digestive systems vary from those of vertebrates.
Plants and berries	Berries, plants, greens and mushrooms mature during the summer and are harvested. Seaweed and kelp grow in a saltwater environment. Some plants may be dried before use.

Appendix P: Summary of general distributional shapes

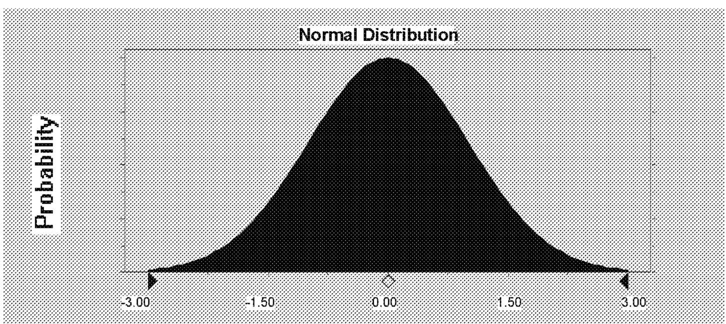
This report references a number of types of probability distributions. What follows is a brief summary of each distribution mentioned in this report, including each generalized probability density function (PDF). The parameters reported in Table 14 as best fits to the harvest data for each resource in each Alaska region are substituted into the generalized PDF for the cited distributional shape in order to determine the specific probability density function for any case. More information regarding the mathematics and general characteristics of these distributions can be found in a number of useful handbooks for probabilistic analysis (Decisioneering, 1996; Evans *et al.*, 1993; Morgan and Henrion, 1990) which served as resources for this project.

Normal Distribution

The normal distribution is doubtless the best known and most often used probability distribution. It is commonly used to represent unbiased measurement or sampling error, among other applications. The normal distribution can be represented by the following probability density function:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left[-\frac{[x-\mu]^2}{2\sigma^2}\right]$$

where μ is the mean value, and σ is the standard deviation. The normal distribution ranges from negative to positive infinity, which often makes it inappropriate for nonnegative data. When the standard deviation is less than 20% of the mean, however, the density in the negative region is extremely small, so that the likelihood of selected an inappropriate value is negligible (Morgan and Henrion, 1990). A graphical example of the normal PDF is shown:

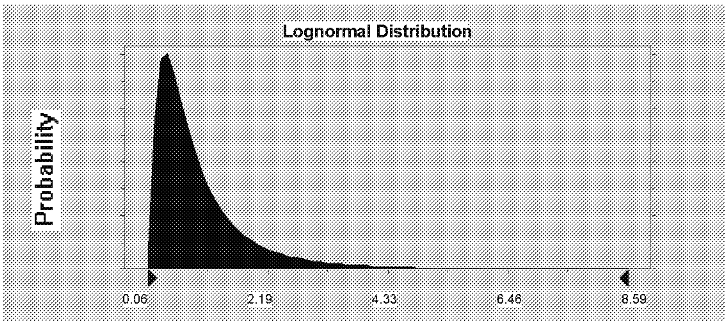


Log-normal Distribution

The log-normal distribution is also used frequently, particularly for nonnegative physical measurements. It occurs when the natural logarithm of a random variable is distributed according to the normal distribution. The log-normal distribution is positively skewed, and ranges from zero to positive infinity, according to the following probability density function:

$$f(x) = \frac{1}{\phi x\sqrt{2\pi}}\exp\left[-\frac{[\ln x - \varepsilon]^2}{2\phi^2}\right]$$

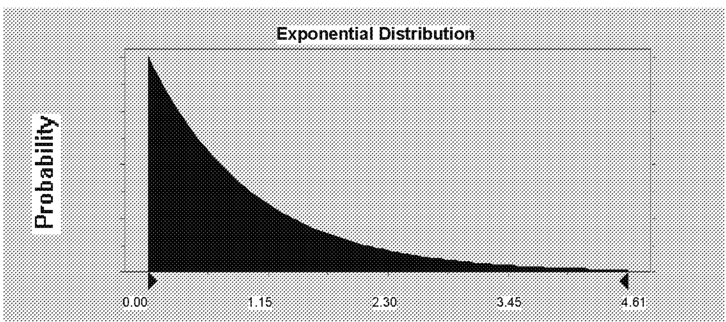
where ε is the mean of the log transformed variable, and ϕ is the standard deviation of the log transformed variable. An example lognormal PDF is displayed:



Exponential Distribution
The exponential distribution is typically used to represent the time between successive random events. It also represents the maximum entropy solution for a nonnegative quantity with a known mean and unknown variance or maximum (Lee and Wright, 1994). The exponential distribution ranges from zero to infinity, with the probability density continuously decreasing, according to the following function:

$$f(x) = \lambda \exp[-\lambda x]$$

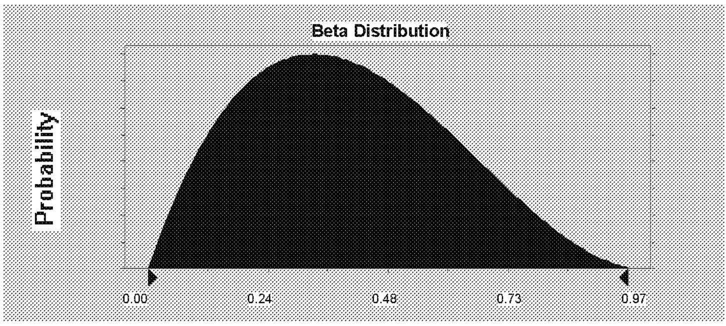
where λ is the mean value. An example exponential PDF is shown:



Beta Distribution
The Beta distribution has multiple forms, varying from two to four parameters. It is used to describe probabilities within fixed intervals, and is well suited to describing error in percentages, probabilities, and other quantities with fixed maxima and minima. The three parameter form which is used in the Crystal Ball software package is given here:

$$f(x) = \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} (x/\omega)^{\alpha-1} (1 - x/\omega)^{\beta-1}$$

where α and β are shape parameters, and ω is the maximum. In this form of the beta distribution, the minimum is fixed at zero. The notation $\Gamma(n)$ stands for the gamma function, which equals $(n\text{-}1)!$ for integers. An example beta PDF is shown:

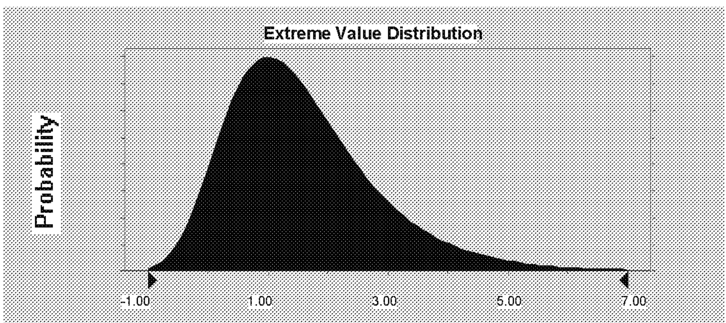


Extreme Value Distribution

The extreme value distribution, sometimes referred to as the Gumbel distribution, expresses the limit of the maximum of many random samples taken from the same distribution. It ranges from negative to positive infinity, according to the following probability density function:

$$f(x) = (1/\beta)\exp\left[\frac{\alpha - x}{\beta}\right]\exp\left\{\exp\left[\frac{\alpha - x}{\beta}\right]\right\}$$

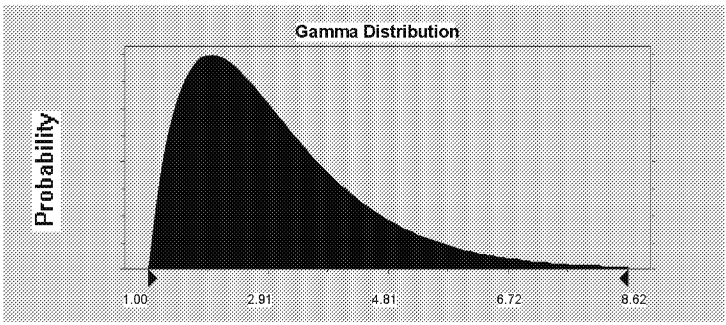
where α is the mode, or location parameter, and β is the scale parameter. An example PDF for the extreme value distribution is shown:



Gamma Distribution
The gamma distribution describes the time required for the occurrence of a specified number of random Poisson events. It is similar to the log-normal distribution, but less skewed, and therefore places less emphasis on the highest values. It is described by the following probability density function:

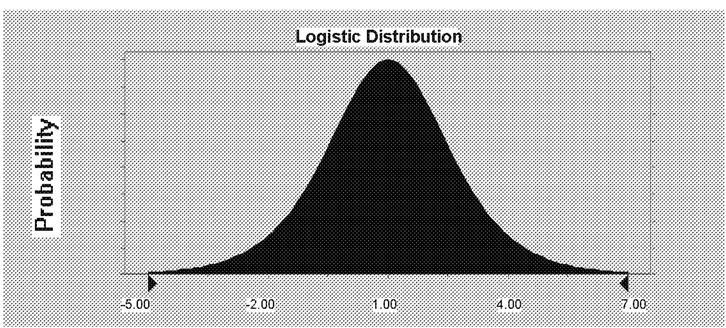
$$f(x)=\frac{\lambda^k x^{k-1}\exp(-\lambda x)}{\Gamma(k)}$$

where λ is the scale parameter, and k is the shape parameter. The gamma distribution is confined to nonnegative values. An example gamma PDF is shown:



Logistic Distribution
The logistic distribution represents the limit of the average of the minimum and maximum values of many random samples taken from an exponential distribution.
It ranges from negative to positive infinity, and is described by a mean (μ) and a scale parameter (β):

$$f(x)=\frac{\exp\left[\frac{\mu-x}{\beta}\right]}{\beta\left\{1+\exp\left[\frac{\mu-x}{\beta}\right]\right\}^2}$$



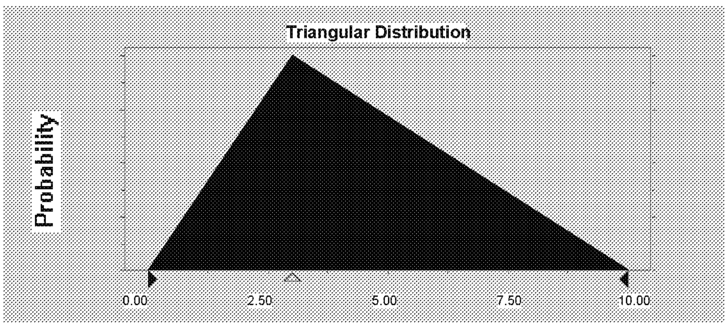
Triangular Distribution

The triangular distribution is a simple expression of three observable parameters, and is often used to visually indicate that inferences have been made from limited data. While the use of the triangular distribution is convenient, some assessors prefer instead to use smooth functions with specific theoretical bases (Seiler and Alvarez, 1996). The triangular distribution has the following probability density function:

For $a \le x \le b$; $f(x) = \dfrac{2(x-a)}{(c-a)(b-a)}$

For $b \le x \le c$; $f(x) = \dfrac{-2(x-c)}{(c-a)(c-b)}$

where a is the minimum, b is the mode, and c is the maximum value. An example of the triangular PDF is shown:



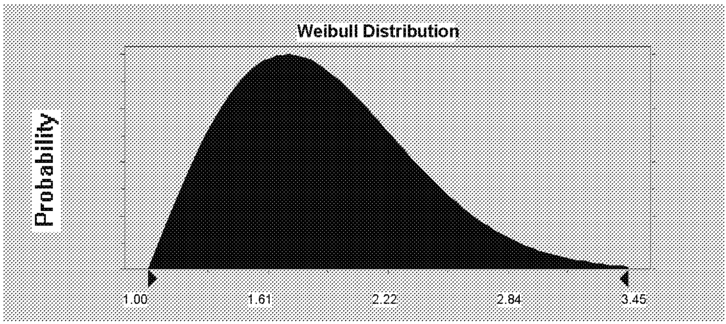
Weibull Distribution

The Weibull distribution is similar to the gamma and log-normal distributions. It is less skewed than both of the other distributions, however, and may become slightly skewed to the negative under certain circumstances. It ranges from zero to positive infinity according to the following probability density function:

$$f(x) = \frac{k}{c}(x/c)^{k-1}\exp\left[-(x/c)^k\right]$$

where c is the scale parameter and k is the shape parameter. An example of the Weibull PDF is shown:

ED_002991_00017357-00161


Weibull Distribution
Probability
1.00
1.61
2.22
2.84
3.45